SCIENCE.

FRIDAY, APRIL 17, 1885.

COMMENT AND CRITICISM.

THE PUBLICATION of Prof. A. Graham Bell's final memoir upon the formation of a deaf variety of the human race shows the extent and thoroughness of his investigation, which has already led to practical results in shaping, in certain states, the public economy in regard to deaf-mutes (*Science*, v. 207). To meet the claims of our readers, we briefly recapitulate Professor Bell's course of argument. He shows, 1°, that there is a marked grouping of deaf-mutes into families, certain surnames recurring frequently, and that the proportion and number of congenitally deaf mutes has in-increased in America, therefore the cause is probably an increasing hereditary tendency; 2°, that, of the deaf-mutes who marry at the present time, not less than eighty per cent marry deaf-mutes, while, of those who married during the early half of the present century, the proportion who married deaf-mutes was much smaller; 3°, that children having deaf-mute relatives are more likely to be congenitally deaf-mute than the children of the people at large (to illustrate this fact, he gives detailed accounts of several families); 4°, that the indications derived from the study of the actual census-tables are, that the congenital deaf-mutes of the country are increasing at a greater rate than the population at large, and the deaf-mute children of deaf-mutes at a greater rate than the congenital deaf-mute population; 5°, that the intermarriage of deaf-mutes is mainly fostered by bringing the deaf-mutes together in institutions, and isolating them thereby, and by teaching them a language (of signs) the people at large do not use.

Professor Bell, therefore, regards the philanthropic efforts which have been made to ameliorate the condition of deaf-mutes as the direct cause of an increase in the number of these unfortunates. A good purpose is the father of an evil result. What a strange antithesis! How striking the important lesson it teaches us of the efficiency of the scientific spirit as a guide in practical affairs, — that spirit which obtains thorough knowledge, and follows out to the end the analysis of cause and effect! The scientific mind, in its best form, is equipped to discover, to derive from new premises their legitimate conclusion: it is reason at its maximum power. This is not the first time that the inventor of the telephone has proved the efficiency of a mind of this quality in achieving results of immediate and far-reaching importance, and added new dignity to science in the estimation not only of thoughtful persons, but also of practical-minded Americans.

THE DOCTRINE that the bodies of all the higher plants and animals are aggregations of myriads of minute, and in many respects independent, cells, had its origin some fifty years ago. Though now universally accepted by biologists as an essentially correct generalization, it has not yet become one of those scientific facts widely known to, and accepted by, the general educated public. To the 'average man,' the proposition that his body is a collection of thousands of microscopic masses of living matter, each of which lives its life in more or less harmony with the rest, but to a great extent without any reference to them, is an astounding one. He finds it nearly impossible to realize that in certain respects he is rather a nation than an individual; that his bodily life is the algebraical sum of the living and doing of hundreds of thousands of cells, much as the vitality and activity of a nation is the resultant of the actions of all its inhabitants. His physical life is to him an entity. In consequence, there is nothing which the physiolo-

gist finds it harder to make comprehensible to the laity, than that a frog, as a complete animal, may be killed by destruction of its nervous system, yet most of its organs remain alive for hours; also the fact that it is not only possible in many cases to isolate particular organs or cells, keeping them alive for study after killing the rest of the plant or animal, but that this is even necessary, if the working of any complex organism is to be really understood. This popular ignorance, like all ignorance, has evil results. Much of the disquietude which many persons now feel in regard to physiological experiment is due to the fact that they do not realize that experiments on living hearts or muscles are usually carried out on animals which, as a whole, have previously been killed by destruction of the brain.

THE REMARKABLE operation so successfully performed by Dr. William Fluhrer of New York, involving no less a difficulty than the probing of the brain-substance itself in search of an embedded bullet, and the extraction of the missile through a counter-opening in the skull opposite the point of entrance, marks a new step in surgery which is startling in its suggestiveness. It could hardly have been anticipated that so complete a recovery would follow an operation of such difficulty and danger, involving as it did the retention in the brain, for a prolonged period of time, of a rubber drainage-tube passing completely through the head from the forehead to the back of the skull. The recovery is more remarkable on account of the additional complication of a severed artery which could not be tied, and which threatened speedy death from hemorrhage. The case illustrates the value of antiseptic or aseptic treatment, as well as the possibility of removing much brain-tissue in man, with thus far relatively little damage, which had already been demonstrated for other animals, notably for the dog. This had, however, been fairly well established for man in some cases of injury, where the surgeon had hesitated to interfere very actively. An account of this remarkable case will be found on another page. While its success would appear to justify a similar procedure under like circumstances, it is still far from certain that the next case would prove so easy of operation.

LETTERS TO THE EDITOR.

Mental capacity of an infant.

APROPOS of 'Acquisition in infants,' I am tempted to state the results of an experiment I made, not long since, to test the mental capacity of Helen R. H., on the day she was fifteen months old, walking actively, but speaking only half a dozen words.

With pencil and paper, and several reliable witnesses present, I sat down, and without making any signs, or allowing signs made by others, the mother and I began to give the child a series of commands, the execution of which involved an accurate knowledge of various verbs, nouns, and pronouns. The commands were given distinctly, very seldom repeated, and were obeyed very promptly, without any questioning or explanation whatever. In one hour's time sixty-one commands were obeyed by the child with absolute precision, which showed a remembrance and correct understanding of thirty-one verbs and fifty-one nouns and pronouns. The commands given were such as the following: 'Kiss your hand,' 'Make a bow,' 'Knock on the door,' 'Blow out the candle,' 'Put the basket on the pail,' 'Put the pan in the pail,' 'Bring the bell, ball, orange,' etc. The words used were such as the child had acquired a knowledge of by observation chiefly; for not one-fourth of them had ever been taught her. I will add, that, while the child is possessed of wholesome brightness and intelligence, she has never been thought precocious. W. T. H.

Nutritive value of cellulose.

In giving an account of some recent experiments upon the digestibility of cellulose by herbivorous animals (*Science*, No. 100, p. 11), the writer took occasion to point out that the conclusions which certain writers had drawn from these experiments, regarding the nutritive value of digestible cellulose, were not sustained by the facts.

The last number of the *Zeitschrift für biologie* (xxi. 67) contains a paper by W. v. Knieriem upon the utilization of cellulose in the animal organism, in which are detailed experiments upon the digestibility of cellulose, and upon its nutritive effect, which strikingly corroborate the belief above mentioned.

The method of experiment adopted is a novel one. It consisted in feeding the animals (usually rabbits) with food containing no cellulose; the necessary bulk being supplied by horn-shavings, which were usually eaten freely, and which, as special experiments showed, were entirely unacted upon in the alimentary canal. After all the cellulose of the previous feeding had thus been removed from the animal, either a fodder containing a known amount of cellulose, or some more or less pure form of cellulose itself, was introduced into the ration. The solid excrements were collected and analyzed in the usual way, and, by means of a return to the original cellulose-free ration, all the indigestible cellulose was finally eliminated from the body.

The digestion experiments offer nothing of special interest in this connection, and we pass at once to the experiments upon the nutritive value of the digested cellulose. These were so arranged as to compare the effect of the latter with that of an equal weight of sugar in two respects: 1°, as to its influence upon the proteid metabolism of the body; and, 2°, as to its influence upon the gain or loss of fat.

The influence of carbhydrates in the food, as is well known, is to decrease the proteid metabolism, as is shown by the diminished excretion of nitrogen in the urine. In v. Knieriem's experiments, 22 grams of crude fibre, of which 11.02 grams were digested, decreased the proteid metabolism by 22%, while 11 grams of cane-sugar decreased it 15.3%: in other words, the digestible crude fibre showed itself more effective in this respect than an equal weight of sugar.

As regards the gain or loss of fat, the advantage is on the side of the sugar; the latter diminishing the daily loss from the body by 2.5 grams, while the cellulose decreased it by 1.7 grams.

These are the results of a single experiment, and, as regards exact numerical values, are of course subject to correction by future investigations. They certainly show, however, that the nutritive value of cellulose is by no means insignificant, and probably not very much below that of other carbhydrates. If, as in the former article, we assume that the heat evolved by the fermentation of the cellulose in the alimentary canal is of use to the organism, then the sole loss by the fermentation is the latent energy carried off in the marsh-gas evolved. In that paper the amount of that loss was estimated on the basis of Henneberg and Stohmann's determinations of the amount of marsh-gas excreted in their respiration experiments. If, instead of this, the amount of marsh-gas evolved in the fermentation of one gram of cellulose be made the basis of the calculation, a somewhat lower value for the cellulose results. According to Tappeiner, one gram of cellulose yields 0.335 grams CO_2, 0.047 grams CH_4, and 0.618 grams of organic acids. One gram of cellulose yields 4,452 cal.; 0.047 grams CH_4, 614 cal.: leaving 3,838 cal. to represent the available heat-value of the cellulose. One gram of cane-sugar yields 4,173 cal.; one gram of starch, 4,479 cal.: consequently, if our fundamental assumption is correct, the value of one gram of cellulose is about 92% of that of cane-sugar, and about 86% of that of starch. These results agree well with those of v. Knieriem's experiments; and the two together appear to justify the conclusion, previously stated, that the nutritive value of cellulose is not greatly inferior to that of other carbhydrates.

H. P. ARMSBY.

The naval observatory publications.

Referring to your criticism in *Science* for April 3, on the delay in printing annual volumes of 'Astronomical and meteorological observations' made at the U. S. naval observatory, I am glad to be able to say that the cause for complaint in this direction has been, at least temporarily, removed; and in future we hope to have our volumes printed as fast as the limited number of computers will permit the proof-sheets to be sent to the printer.

During the closing days of congress, the following resolution was introduced and concurred in: "That the annual volume of the 'Astronomical and meteorological observations' of the naval observatory for the years 1881 and 1882 be printed, and that 2,000 additional copies of each volume be printed, of which 400 copies will be for the use of the senate, 800 for the use of the house, and 800 for the use of the navy department, or for sale at the cost of paper and printing."

The manuscript sheets of the volume for 1881 are now in the hands of the printer, to be followed immediately by those for 1882; so that both of these volumes will be distributed this year, and it is hoped that we will continue to be able to have (as you very pertinently suggest) all annual volumes printed independently of the regular appropriation for the navy department.

ALLAN D. BROWN,
Commander, U. S. navy.

U. S. naval observatory, Washington, D.C., April 6.

An attempt to photograph the corona.

Mr. Pickering's interesting experiments described in *Science* for April 3 would seem to be practically conclusive as to the unreality of the coronal forms which appear upon the plates of Dr. Huggins and Mr. Woods, if it were evident that he had observed all the conditions which they indicate as essential.

His letter, however, is silent in respect to one important point. It is not stated whether or not the plates were 'backed' with any light-absorbing substance, in order to prevent the so-called 'halation' produced by reflection from the back surface of the plate under a strong light. The English observers insist urgently upon the necessity of this precaution, and use for the purpose, I believe, a coat of asphalt varnish, colored with Brunswick black. It is possible that even this expedient would not wholly prevent a streaky scattering of light at the edge of the sun's image, because minute particles of foreign matter embedded in the glass itself would have their influence; but it is obvious, that, if the experiment was tried without the precaution, it cannot be looked upon as any way decisive.

Perhaps Mr. Pickering would kindly supplement his communication by a brief statement regarding this point.

C. A. YOUNG.

Princeton, N.J., April 8.

In reply to Professor Young's communication, I would say that the precaution to which he refers was carefully attended to, and that all the plates employed were backed the day before the eclipse with asphalt varnish. It would be very interesting to know how far the corona, as photographed by Dr. Huggins, extends from the sun: for a very long exposure would probably mask the real phenomenon; one that was very short would be insufficient to obtain an impression of it. My exposures were so timed, that, by a long development, the darkening could be traced to a distance of .8 of the sun's diameter, while, with a short development, the darkening only reached to .2. But in no case could any particular rays be identified in the different photographs.

WM. H. PICKERING.

Sir William Thomson's Molecular dynamics.

As it is possible that some of your readers may have obtained copies of the papyrograph report of my lectures on molecular dynamics, delivered at Baltimore during October, 1884, I should be obliged by your giving publicity to the following corrections: —

P. 34, lines 18 and 19, delete 'We may call it a dynamax but not a paradox.' I have no recollection of, nor can I imagine, what the word was that I suggested as more logical than 'paradox.'

P. 59, line 14, for 'distortional' substitute 'condensational.'

P. 296, in the two expressions for ψ, given in equation (17), insert 'tan i' before '$\frac{(\mu^2-1)^2}{\mu^2+1}$;' also in the expression for 'tan e' and 'tan e_1,' of equation (20), insert 'tan i' before '$\frac{(\mu^2-1)^2}{\mu^2+1}$.' The formula from which these expressions are deduced is correctly given at the foot of p. 295.

P. 296, in line 13 from top of the page, and in the left-hand members of equations (20) and (21), for 'w' and 'w_1,' read 'ω' and 'ω_1' respectively.

WILLIAM THOMSON.

The university, Glasgow, March 26.

The cold weather of February and March.

During the past two months the cold weather has been of unusually long duration; so much so, that in many places in and about the city the water and gas pipes, which are placed about four feet under the ground, have been frozen. This being the case, I have thought that it would be interesting to see, from the records of Draper's continuous self-recording thermometer of this observatory, what was the difference in the duration of the cold in this year, as compared with last. The following table shows the comparison of temperature every ten degrees, from the lowest to the highest, for the years 1884 and 1885, during the months of February and March, and also the number of times or hours the temperature was below or above 30°, which has been taken as a temperature of neither freezing nor thawing.

Degrees.	1884.		1885.	
	Hours' duration.		Hours' duration.	
	February.	March.	February.	March.
−10 to 0	–	–	2	–
0 to 10	14	11	44	5
10 to 20	30	71	191	139
20 to 30	97	105	250	157
Hours of cold	141	187	487	301
30 to 40	375	223	155	362
40 to 50	152	225	30	62
50 to 60	28	102	–	19
60 to 70	–	7	–	–
Hours of heat	555	557	185	443

Hours of cold, in 1885, for February	487	
Hours of cold, in 1885, for March	301	788
Hours of cold, in 1884, for February	141	
Hours of cold, in 1884, for March	187	328
Difference of hours of cold between the two years		460

There were therefore, during these two months, 460 hours more of cold in 1885 than in 1884.

DANIEL DRAPER, PH.D.,
Director.

CIVIL AND ASTRONOMICAL TIME.

THERE seems to be a good deal of doubt whether the recommendations of the Prime-meridian conference are going to be very generally accepted. France, and the nations under French influence, certainly will not adopt the new anti-Greenwich meridian for many years, if ever. The matter is really one of comparatively little importance; that is to say, it will make no very great practical difference to any one if different nations continue to use different meridians: still there can be no question that there would be a real and considerable convenience in the establishment of a single meridian, and consequently of a time-system, which, like our present railroad-time in the United States, would be identical as to minutes and seconds all over the earth. It is probable that the gentle pressure of this convenience will, after a while, bring about the desirable concurrence, especially as the increasing extent and rapidity of travel and communication will all the time bring out more forcibly the inconveniences of the present state of affairs, and tend to weaken mere local feeling and prejudice, which, after all, is the main obstacle at present to the universal adoption of the meridian proposed.

The recommendation that astronomers should come into agreement with other folks, and begin their day at midnight instead of the following noon, as at present, seems especially likely to fail. The Greenwich observatory, indeed, adopted the new plan on Jan. 1; but, so far as we know, no other important astronomical establishment has yet done so. Commodore Franklin, of the U. S. naval observatory, proposed to follow the example of Greenwich, and issued an order to that effect; but it excited so much opposition from certain eminent and influential astronomers, that the order was suspended before the time came for it to go into operation.

The objections of Professor Newcomb, who has formulated more fully and forcibly than any one else the reasons why the change should not be made, relate not so much to the fact that astronomers would find it inconvenient to change the date of their observations at midnight, as to the confusion that would be likely to result in the combination and comparison of observations taken before the introduc-

tion of the new system, and after it. The same sort of difficulty now exists in comparing observations made before and after the introduction of the Gregorian calendar; but in this case the discontinuity amounts to ten or eleven days, and cannot escape notice, while the discontinuity involved in the proposed system would be only twelve hours, and might easily be overlooked with most damaging consequences. This objection is undoubtedly valid and weighty. The other objections urged, as to changes needed in the ephemerides, really amount to very little. At present, one has to stop a moment to consider whether he is acting as a *civilian* or an *astronomer* when he opens the Ephemeris to look out data; and it is quite immaterial as regards the numbers given for *noon*, for instance, whether noon is called 0 h. or 12 h. As to the changes in the printing of the Ephemeris, they would involve a little extra work the first year, but nothing of any consequence.

Per contra, a considerable majority of the astronomers consulted by Commodore Franklin were of opinion that the advantage gained by abolishing the distinction between civil and astronomical reckoning would fully compensate for the admitted annoyance consequent upon the change. The number of people inconvenienced by the change would be very small, and they would be persons abundantly able to guard against mistakes such as others would be likely to make. On the other hand, the present system leads to confusion in the case of all neophytes in astronomical work: indeed, pretty good astronomers are sometimes caught napping when they look into the almanac for forenoon data; and in publishing observations it is often necessary, and always wise, to state whether civil or astronomical reckoning is used. Of course, the change in itself considered is of very little importance; but it does seem rather unfortunate that the recommendations of the Washington conference should fail, to begin with, at the Washington observatory, and the effect will undoubtedly be to postpone the acceptance of the whole system of proposed reforms.

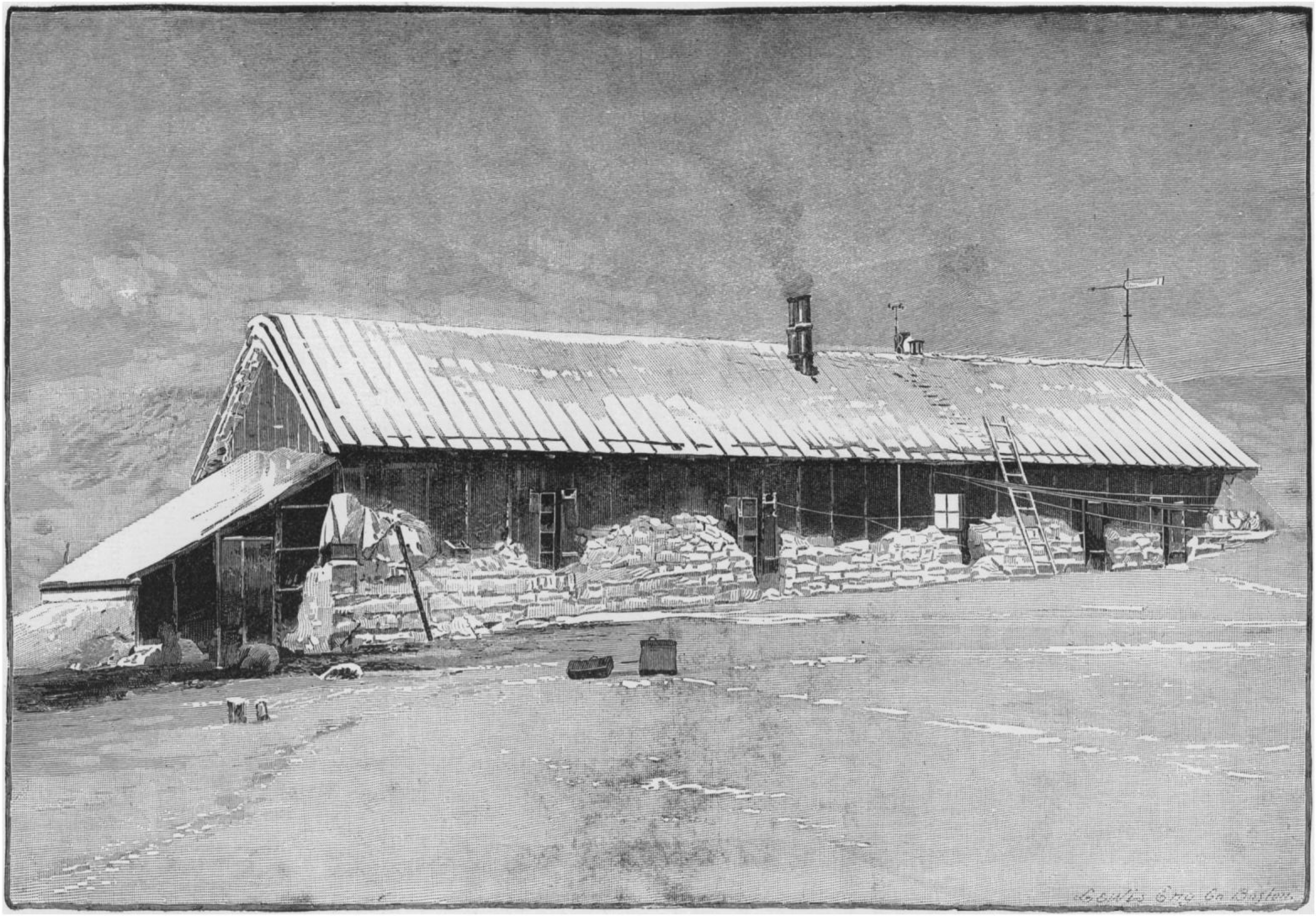
THE SCIENTIFIC RESULTS OF THE LADY FRANKLIN BAY EXPEDITION.[1]

THE general interest in the scientific work of most polar expeditions has been seriously affected by the long delay which necessarily occurs in the publication of the records and results. With the permission and concurrence of Gen. W. B. Hazen, chief signal-officer, I take pleasure in giving, as far as I can at present, a brief summary of some of the scientific results of the Lady Franklin Bay expedition.

Hourly magnetic declination observations for thirty-two days on which they were made previous to July 1, 1882, were reduced at Fort Conger. The mean declination thus obtained was 100° 12′ west, being 1° 32′ less than the result deduced from the observations of the English expedition of 1875–76. The maximum easterly deflection occurred at 2 A.M., local time (7 A.M., Gottingen mean time), and the maximum westerly deflection at 12 M. A primary maximum at 4 P.M., most probably was due to disturbances. These deflections are from one to two hours later than those obtained from the observations of Lieuts. Archer and Fulford, R.N., in 1875–76; but it is possible that the observations for the complete year, which are now in the hands of Assistant Charles Schott of the U. S. coast and geodetic survey for reduction, may give other results. The hours, however, agree with those determined for Van Rensselaer harbor by Mr. Schott, in the discussion of Kane's observations. The absolute range of the English observations was 8°; and the greatest daily change, 5° 9.4′. From 8.35 A.M. (Gottingen mean time), Nov. 16, 1883, to 10.30 P.M., Nov. 18, the absolute range as observed was 20° 28.2′, — from 113° 19.8′ west, to 92° 51.6′ west. These times and figures are given as of more than common interest in connection with the great magnetic storm of November, 1883. The changes at Conger were much greater, it will be observed, than at Godthaab, Greenland, where, Paulsen says, on Nov. 17, 1883, from 2 A.M. until noon, the declination had varied 4° 44′ to the east, and later about 5° to the west; so that the variations for the day reached 9.5°.

The following table of monthly means has

[1] The accompanying picture represents Fort Conger as it was photographed by Sergeant George W. Rice, in March, 1882, the print from which it was taken being one of the few that were brought safely home by the Greely party. The high ground at the north-west of the station is seen at the left. The picture represents the principal building occupied. There were three other small structures, astronomical and magnetic observatories, and an instrument-shelter, the wires seen at the right running to the astronomical observatory.



THE STATION OF THE GREELY PARTY AT LADY FRANKLIN BAY.

been compiled from three years' observations,—1875–76 and 1881–83.

	Barometer to sea.	Temperature.	Rainfall, inches (two years only).
January	29.756	−38.3°	0.42
February	0.779	−40.1°	0.13
March	0.962	−28.3°	0.45
April	30.175	−13.6°	0.17
May	0.021	+14.1°	0.40
June	29.852	32.7°	0.18
July	0.725	37.1°	0.66
August	0.787	33.8°	0.38
September	0.749	15.8°	0.35
October	0.925	− 8.9°	0.24
November	0.971	−23.3°	0.20
December	0.830	−28.1°	0.30
Year	29.878	− 3.9°	3.88

The barometrical observations show atmospheric changes which I believe are common to the region within the arctic circle, north of America at least. The marked maximum pressure in April gives way rapidly to the principal minimum in July; to be followed by a secondary maximum in November, and a less marked minimum in January or February.

The hourly barometric observations are of special interest as tending towards a final solution of the question whether or not the regular diurnal variation observed in lower latitudes also occurs near the poles. Buchan, noting the fact that the range at St. Petersburg and Bosukop is but about .012 of an inch, remarks, "And in still higher latitudes, at that period of the year when there is no alternation of day and night, the diurnal variation probably does not occur."

The first year's observations at Fort Conger satisfied me that such diurnal variation does occur in very high latitudes, and my opinion was confirmed by subsequent observations. Reductions made several months before the station was abandoned, from nearly five hundred days' continuous observation, showed a range of .0099 of an inch. The primary maximum occurs at 5 A.M., Washington mean time (which is 53 minutes slower than local time), followed by the primary minimum at 1 P.M. The secondary maximum and minimum took place at 6 P.M. and midnight respectively. To determine whether the presence or absence of the sun affected the fluctuation, I calculated separately the means of the days of continual darkness and continuous sunlight up to May 1, 1883. The diurnal fluctuation was substantially the same, and the critical hours were identical in the arctic night and in the polar day.

The absolute range of the barometer observed was 2.032 inches, — from 31, April 9, 1882, to 28.968, Feb. 19, 1883. It is interesting to note that the minimum pressure for the year 1882–83 at Godthaab and in Spitzbergen occurred respectively one day earlier and three days later than at Fort Conger. The barometer at Godthaab touched the unusually low point of 27.89.

The annual mean temperature (−3.9°) is the lowest on the globe, being 1.4° below that deduced for Van Rensselaer harbor from Kane's observations. It quite disposes of the theories of a warmer climate as the pole is approached. The maximum mean at Fort Conger agrees with that of other arctic stations in general, occurring in July; and the monthly mean gradually declines to the minimum in February. This month, I think, is generally the coldest at arctic stations; and, when the lowest mean has been noted in January (or occasionally in March), I believe a series of years would change it to February. The lowest monthly mean (−46.5°) for February, 1882, must give way, however, to that at Werchojansk (on the Lena), from which the following means are reported: December, −50.3°; January, −56°; and February, — 53°. The highest monthly mean was that of July, 1883, 37.2°. The absolute range of temperature was 115.1°,— from −62.1°, Feb. 3, 1882, to +53°, June 30, 1882.

The amount of rain and melted snow was 3.95 inches the first, and 3.82 the second year, irregularly distributed throughout the year. This small amount of precipitation may explain the non-glaciation of the adjacent country. I believe the precipitation in the interior to be less than at Fort Conger.

The wind resultants are as follows: first year, S. 61.4° E. 7594 miles; second year, S. 67.3° E. 6437 miles. The wind was more southerly from 2 to 4 P.M., inclusive, than at other hours during the first year, and from 11 A.M. to 2 P.M. the second year.

The mean tidal establishment was determined by me at Fort Conger from two years' observations on a fixed gauge, as follows: —

High water (1314 tides)	11 h. 33.9 m.
Low water (1314 tides)	17 h. 45.7 m.

Complete series of high and low waters for two years, with regular hourly readings of the tide for one year at Fort Conger, have been placed in the hands of Mr. Schott. These observations, with supplementary simultaneous readings at Capes Sumner, Beechy, Craycroft, Leebi, and at Repulse harbor, added to Bessel's and Nares' observations, will, I trust, enable

tidal experts to determine the co-tidal curves for Lincoln Sea, and Robesen and Kennedy channels.

The temperature of the surface sea-water was carefully observed from October, 1882, to June, 1883. The temperature fell steadily from a mean of 29.2° in October, to 29° in December, and then rose steadily to 29.4° in June. The ebbing tide (to the north) was from 0.1° to 0.2° colder than the flowing tide, and its mean for December was 28.9°.

The sounding of 133 fathoms and no bottom, midway between Capes May and Britannia, is significant of a different ocean along the north coast of Greenland, from the shallow sea north of Asia, North America, and Grinnell Land.

Forty-eight swings, with accompanying time observations, were made with a pendulum furnished by the U. S. coast and geodetic survey. The observations are now in the hands of Assistant Charles S. Peirce for reduction and comparison. I regret that continued mental and physical weakness have prevented more careful and systematic treatment of these subjects. This summary is now presented, as the immediate future promises no better results from my hands. A. W. GREELY, *U. S. army.*

FOOTPRINTS IN THE ROCKS OF COLORADO.

FROM a few tracks and signs, an Indian is said to have inferred that at noon there had passed by a white man, lame in the left foot, blind in the right eye, dressed in gray, and with a double-barrelled gun and a black dog. With no attempt to rival the aborigines, nor to name and classify, it is interesting to notice some features of the footprints on four slabs from St. Vrain Creek, Col., — the only vestiges of animal life thus far reported from the immense beds of triassic sandstones in the eastern Rocky Mountains. Three of the slabs are in the museum of Iowa college, Grinnell, Io.: the other, No. 2, has been sent to the national museum.

Slab No. 1, represented in the figure, with two of the tracks on a larger scale, is somewhat like the rare horseshoe forms found in Europe and in the Connecticut valley, in rocks of the same age. No hoofed animal is supposed to have existed at so early a period. The shape has been attributed to a membrane beneath claws, in this case a firm, flat pad, if that be the explanation, and semicircular within as well as exteriorly. In the three forward tracks, the fore and hind feet coincided, making one impression. In four of the remaining tracks, the smaller fore-feet show a crescent that coalesces with that of the hind-foot. There is a rough, *broken*, irregular bulging of the rock in and behind the hollow of the foot, dying away backward into the surface. The great amount of this would suggest that the animal was ascending a wet slope.

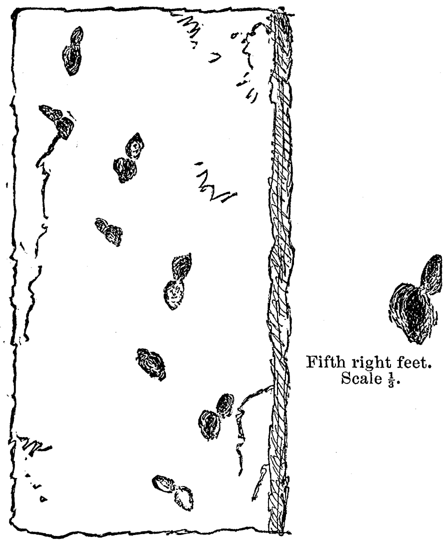
The appearance of slab No. 3 is so like No. 2 that they were probably one continuous series. As seen in the figure, the larger impression of the hind-foot mostly touches, and once or twice somewhat overlaps, that of the fore-foot, which is evidently such because its position varies relatively to the former. It has a wide angle from the line of progression. In the last (uppermost) left feet, the fore-foot repeats its print, though at first glance it looks like a jointed toe. All the impressions are simple ovals (ellipses), deepest in the centre; and several, as in the larger separate figure, have a shallow ear-shaped impression on the inner forward border, which, in two, shows slight lengthwise wrinkles. The left-side tracks are less perfect, as if the right feet pressed on a lower, wetter part of the ancient beach.

In No. 3 there was an inch space between the heels in passing each other; in No. 1, little

SLAB NO. 1.
Average stride, $8\frac{1}{2}$ inches; width of trackway, $4\frac{1}{4}$ inches. Scale, 1-12.

or none. The animals must therefore have had an erect habit, not the dragging movement, with horizontally extended legs, of ordinary reptiles, if reptiles they were.

Slab No. 4 has nine pairs of hind-foot tracks, with the fore-feet sometimes coinciding, and elsewhere separated at considerable distances. They are in relief, that is, on the under side



SLAB NO. 3.

Average stride, $8\frac{1}{4}$ inches; width of trackway, $4\frac{1}{2}$ inches. Scale, 1-12.

of the layer, and resemble Nos. 2 and 3, but smaller; and the stride is two inches less.

Thorough search was made among the vast quantities of waste stone in the main quarries, and also in those of Stone Cañon adjoining, as well as in the streets of Denver, where these red quartzitic sandstones are largely used for flagging. The scarcity of the tracks is emphasized by the abundance of raindrop impressions. There were also many irregular stellate moulds, left by some crystallization, which a quarryman mistook for tracks.

H. W. PARKER.

SUCCESSFUL EXTRACTION OF A BULLET FROM THE BRAIN.

THE *New-York medical journal* of March 28 gives an account of an interesting surgical operation recently performed in New York, from which we condense the following statement: —

On the 24th of January, 1884, a healthy young man, Bruno Knorr, nineteen years old, was admitted into one of the wards at Bellevue hospital, suffering from a pistol-shot wound penetrating the brain through the centre of the forehead. The patient was semi-unconscious, and when aroused was irritable, and in answer to all questions simply grunted 'ja.' It was thus impossible to ascertain the circumstances of the occurrence of the injury. It has since, however, been learned from the patient, that, while lying upon his back, he shot himself with a pistol held in contact with his forehead. There was complete loss of motion without loss of sensation on the right side of the body, below the head. There was increased sensitiveness on the left side, which was very marked upon the left side of the scalp near the ear.

Preparatory to the operation, the patient's scalp was shaved. He was then etherized. A flap of gutta-percha tissue was fastened to his forehead to protect his eyes from the antiseptic solution used.

The bullet-hole in the skull, which was about half an inch in diameter, was then enlarged with a Ronguer forceps; but during the process a small clot was disturbed, which gave rise to arterial bleeding from beneath a depressed fragment of the skull whose sharp, convex edge had been driven into the brain. Upon the removal of this fragment the arterial hemorrhage was alarmingly profuse, and it became evident that the patient would speedily bleed to death unless it could be stopped.

After many unsuccessful attempts, Dr. Fluhrer succeeded in catching the artery with a Langenbeck's artery-forceps, and, while he held the instrument, an assistant attempted to tie the vessel. Unfortunately, during the process the delicate artery was torn, and it was found impossible to reach the remaining portion without removing another piece of the skull which covered it. In the mean time, the hemorrhage was so great as to threaten the patient's life. This was partially arrested by an assistant, who passed his finger through the opening in the skull, and compressed the artery against the brain, while Dr. Fluhrer removed a disk of bone sufficiently large to enable the artery to be reached with a Pean's forceps. With the aid of two pairs of dissecting-forceps, he succeeded in passing a silk ligature around the artery, and tying it. Upon the removal of the Pean's forceps, however, the pulsations of the artery and brain loosened and threw off the ligature, so that the bleeding became as profuse as before. The vessel from which the blood flowed was found to have been severed near its junction with a large artery, which Dr. Fluhrer now seized below the point of bifurcation. He saw clearly that the short branch could not be tied; and fearing that the slightest movement of the patient's head might tear the delicate vessel from the forceps, and cause an inevitably fatal hemorrhage, he transferred the artery to the grasp of the short and light clamp shown in fig. 1, which could lie in the wound with-

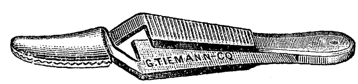


FIG. 1. — SMALL ARTERY CLAMP, ACTUAL SIZE.

out risk of detachment. No further attempt was made to ligature the artery, and the metallic clamp was left in the brain for many days. Two and a half hours had been spent in reaching this stage of the operation. Having arrested the hemorrhage, Dr.

Fluhrer proceeded with his attempt to follow the course of the ball with the probe. The patient's head was now placed in such a position that the presumed track of the ball was perpendicular to the horizon. A perfectly straight Nelaton's probe was then passed perpendicularly into the brain to a depth of about six inches, when a soft resistance was felt, which no effort was made to overcome. The depth to which the probe had passed supported the hypothesis that the bullet had gone completely through the brain, and had struck the opposite side of the skull. In order to ascertain the probable locality of the impact, the probe was left standing in the brain, and the point on the back of the head was noted at which the probe would emerge if projected through the brain. This was presumed to be the point of interior impact. An opening was then made in the skull at a point three-quarters of an inch lower down in the supposed plane of the path of the bullet, and the membrane covering the brain was carefully slit so as to admit the end of the index-finger. A resistance was felt in the brain at the depth of about half an inch, which was believed to be the bullet. Instead of exploring this resistance with a needle, it was decided to continue the opening in the skull upwards until the point of impact was reached, and then extract the bullet through the opening it had itself made. This was successfully accomplished.

The patient's head was then placed in the same position as at first, and the probe was again introduced through the opening in the forehead, and, as before, it encountered a soft resistance at about the depth of six inches. Leaving the probe standing upright, the finger was carefully introduced into the brain from the opening at the back of the skull, and the discovery was made that the obstruction to the passage of the probe was due to the *dura mater* alone. This was remedied by slitting the membrane, and the end of the probe then appeared at the opening in the back of the head. A small-sized rubber tube was attached to this end, and drawn through the brain by the removal of the probe. The tube was left in the brain for drainage-purposes, and the patient's wounds were then dressed.

The operation, which had been conducted throughout with antiseptic precautions, was completed in about four hours from its commencement, the greater portion of the time having been spent in stopping the cerebral hemorrhage.

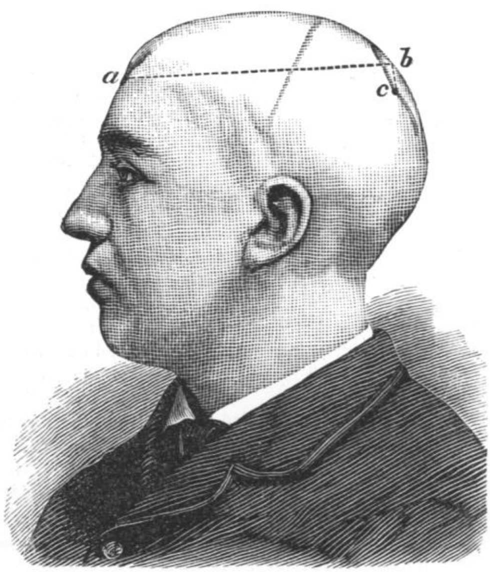


Fig. 2.

In addition to Dr. William F. Fluhrer, the following members of the house staff were present, and witnessed the operation: Drs. R. T. Morris, J. R. Conway, jun., W. W. French, J. H. Woodward, H. N. Williams, P. Oppenheimer, H. S. Wildman, H. Herman, H. Biggs, E. Hurd, C. F. Roberts, and W. G. Rutherford.

On May 22, 1884, Dr. Fluhrer exhibited Knorr at Bellevue hospital to a number of physicians. He was then, so far as could be judged, in perfect health. Apart from the scars upon the patient, the only abnormality discoverable was a limitation of the visual field for green and red, observed by Dr. W. F. Mittendorf. Inasmuch as this feature was common to both eyes, it is questionable whether it was caused by the injury.

The engraving, fig. 2, is from a photograph of the patient taken at that time. The light line marks the position of the fissure of Rolando. The bullet entered at the centre of the forehead, an inch and a quarter above the upper level of the eyebrows: it passed in a straight line through the brain, from *a* to *b*, and was deflected to *c*, where it lodged.

The patient left the hospital, where he had for a long time been retained simply for observation, on June 30, 1884, and in a month went back to work at his old employment in a butcher's shop. He remained at work during the exceptionally hot weather in the early part of September.

On Sept. 12, between twelve and one o'clock in the morning, Knorr received a heavy blow in the anterior scar from the elbow of the man with whom he was sleeping. Knorr states that he suffered intense pain in the head for half an hour, when it died away, and he fell asleep again. He awoke at about four o'clock, and noticed, with wonder, his right forearm beginning to flex upon the arm. He tried to hold it down with his left hand, but failed. Then his right leg was drawn up. Then his left upper and lower extremities respectively became affected in the same manner. He remembered being asked what was the matter, and that he could not speak, but screamed, and then lost consciousness. The convulsive movements were so energetic, that the patient was thrown from his bed upon the floor; nevertheless, he was able to return to work the same day.

On Oct. 1, while delivering a parcel at the house of a customer, he was seized with a slight rigidity, followed by a short convulsive movement of the

limbs, and a momentary loss of consciousness, but did not fall.

He has now had no recurrence of convulsions, or other epileptic symptoms whatever, for a period of nearly six months. When he began working after his discharge from the hospital, he noticed, in trying to keep in mind the orders for deliveries to customers, that his memory was not so good as before the injury. He now follows the same occupation, and performs the same duties in it, as before he was shot. He feels perfectly well, and, by the test mentioned above, is sure that his memory is constantly growing more retentive.

THE DEBATE ON VIVISECTION AT OXFORD.[1]

IN our last issue we gave a brief notice of the proceedings in an overflowing convocation at Oxford, which resulted in a majority of 412 votes to 244 in favor of the decree promulgated by the Hebdomadal council. This decree had only an indirect bearing upon the question of vivisection; but as it was made an occasion for a fresh, and, let us hope, a final, trial of strength between the scientific and anti-scientific forces of the university, it is desirable to furnish our readers with a somewhat more full account of what took place than we had time to print last week. Seeing that the debate had clearly been organized with no small amount of care on the side of the anti-vivisectionists, and that the ablest as well as the most authoritative speakers in Oxford who could support their cause were put forward, we may regard the arguments which were adduced as a fair example of the best that can be said against vivisection by cultured thought and cultured speech. We will therefore confine our remarks to what was said on this side of the question.

Regarded as a piece of oratory, the speech of Canon Liddon was, in our opinion, perfect; and the effect of what we may term an artistic eloquence was enhanced by the appearance and costume of the speaker, as well as by the appropriateness of his surroundings in the densely crowded Sheldonian theatre. But when we look from the manner to the matter of his speech, we are unable to bestow such unqualified praise, although we confess that even here we were agreeably surprised by the judicious moderation of its tone. His views, briefly stated, were, that so long as we hold it morally lawful to kill animals for food, or otherwise to use them for our own purposes, so long must we in consistency hold, that, under certain circumstances, it is morally lawful to inflict pain upon animals for the benefit of man. The special case of vivisection does not differ in principle from other cases where pain is thus inflicted; but it ought to be qualified by three conditions: it should be resorted to as rarely as possible, it should be guarded against the instinct of cruelty, and it should be so used as not to demoralize spectators. With all this, every physiologist would of course agree. The canon, however, proceeded to talk what, in the strictest meaning of the word, must be termed nonsense, when he affirmed that physiology might be 'divorced' from vivisection. That this statement has gained currency among the anti-vivisectionists does not alter its essentially unreasonable character. It is perfectly true that in many departments of physiological research vivisection is not required; but it is no less true that in many other departments vivisection is an unconditional necessity. This fact, one would think, admits of being rendered obvious to any impartial mind, howsoever ignorant of physiological science; for, if this science consists in the study of vital processes going on in the living organism, does it not obviously follow that some of them can only be studied while actually taking place? How, for example, would it be possible to gain any knowledge of the electrical and other changes which occur in a gland during the process of secretion, except by estimating these changes during the act of secretion? The gratuitous information which physiologists receive from technically ignorant sources, touching the nature and the value of their own methods, can only suggest the presumption of inexperienced youth when venturing to instruct a maternal grandparent in the practical aspects of oölogy.

It appears that Professor Burdon-Sanderson had pledged himself not to exhibit vivisections to his class for the purposes of teaching, and for this concession to the unreasoning prejudice of his opponents he received a warm expression of gratitude from Canon Liddon. Probably enough, under the circumstances in which he is placed, the concession is a prudent one; but that it merited the eulogium which was bestowed upon it by Canon Liddon on moral grounds, no man of common sense could very well suppose. Demonstrations on the living subject, if performed in a class-room at Oxford, would of course be always performed on animals under the influence of anaesthetics; and therefore the 'demoralizing' effects upon the minds of young men, which Canon Liddon takes to have been averted by Professor Sanderson's concession, can only be understood to consist in disregarding the mawkish sentimentality which cannot stand the sight of a painless dissection. This kind of 'morality' may be regarded as tolerable in a girl: in a man it is not tolerable, and deserves the same kind of pitying contempt as is accorded to personal cowardice, with which it is most nearly allied.

Canon Liddon, however, regretted that Professor Sanderson had not further pledged himself to restrict his experiments *for the purposes of research* to animals kept under the influence of anaesthetics during the operations, and killed before recovering from their anaesthesia. We have no doubt that Professor Sanderson might have complied with the first of these suggestions without any serious detriment to his future researches; for, as a matter of fact, the cases in which anaesthetics interfere with the progress of an experiment, are, comparatively speaking, very rare indeed,

[1] From *Nature* of March 19.

except where the occurrence of pain forms a necessary part of the experiment; i.e., in certain researches on the functions of sensory nerves. But as all the functions of sensory nerves which require for their study the infliction of pain have already been worked out, physiology, as it now stands, does not demand the absence of anaesthetics, save in a very small percentage of operations: therefore, when pain is inflicted during an operation, it is due, as a rule, not to the exigencies of research, but to the indifference of the operator, — a fact which we think physiologists ought to be more insistent than they are in impressing upon the mind of the public.

Nevertheless, we feel persuaded that Professor Sanderson was perfectly right in not binding himself never to operate without anaesthetics: for by so doing he would have virtually conceded the principle that the suffering of an animal is too great a price at which to buy an advance of knowledge; and this, among other things, would have been to place a moral stigma upon some of the most valuable researches of the past. Besides, as was pointed out in the course of an able speech by Professor Dicey, it is not desirable that the *status* of a professor in the university should be regarded as beneath that of a gentleman; and, if it is supposed that Dr. Sanderson is not to be trusted in the latter capacity, he ought never to have been chosen to fill an Oxford chair. In short, as the representative of physiology in Oxford, Dr. Sanderson, by the nature and extent of his concession, has drawn a clear distinction between the importance of teaching and of research: he has consented to allow the teaching to suffer, if needs be; but he will not consent to yield an inch where the principles of research are concerned.

The other suggestion which was thrown out by Canon Liddon — namely, that a professor of physiology ought to pledge himself to kill every animal before it recovers from its anaesthesia — is, from every point of view, absurd. In the first place, the suggestion can only emanate from the uninformed supposition that the pain of a healing wound is considerable. But we know, from the experience of hospital practice, that even the most severe wounds are painless while healing, unless the process of healing is complicated by morbid conditions, which now admit of being wholly prevented by antiseptic methods. As a matter of fact, therefore, in our physiological laboratories, as in our surgical wards, there is at the present time but an extremely small amount of suffering to be found in connection with the healing of wounds; and no man of ordinary sense, who had ever seen the inside of either the one or the other, would have cared to make the suggestion which we are considering. But in the next place, even if this were not so, it would have been highly wrong in any professor of physiology to restrict himself to the performance of experiments the objects of which could be secured during the action of an anaesthetic. Certainly more than half the experiments which the physiologist has now to perform have reference to questions of after-effects, and this is especially the case in experiments bearing upon the problems of pathology.

The speech of the bishop of Oxford was bad, both in logic and in taste. It was bad in logic, because, in arguing for the total suppression of physiological research in Oxford, he relied upon foreign practice for his evidence of cruelty. This was essentially illogical, because it fails to distinguish between two very different things; namely, the cruelty, if any, which attaches to vivisection *per se*, and the cruelty which arises from other sources. If the state of public feeling in some foreign countries is not so sensitive as it is in our own on the matter of inflicting pain upon the lower animals, it is obviously unfair to search through the continent for instances of cruelty in connection with physiological research, and then to adduce such instances as proof of cruelty necessarily attaching to physiological research at home. We might as well argue against the use of mules in England because these animals are badly treated in Spain. As we have already said, there are now but extremely few cases possible in which the occurrence of pain is necessary for the purposes of an experiment; and therefore the proof of pain having been inflicted in any one case constitutes proof, not of the pain-giving character of vivisection in general, but of the carelessness of some operator in particular. The cruelty must belong to the individual, not to the methods; and we are not aware that any charge of cruelty has hitherto been proved against an English physiologist.

The bishop of Oxford's speech was bad in taste, because he sought, missionary-wise, to tell some anecdote of horror, which the good sense of convocation prevented him from narrating, further than that the subject of his story was to have been 'An affectionate little dog.' But as he was not able to give any reference to the scene of his tragedy, after a prolonged battle with his audience upon this somewhat necessary proof of authenticity, he was obliged to give way. His taste was perhaps still more questionable, when, in the presence of Professor Sanderson and other working physiologists, he proceeded to adduce the favorite argument that the pursuit of experimental physiology exercises a baleful influence on the moral nature. That the argument is unsound, both in principle and in fact, we need not wait to show.

The speech of Professor Freeman was rendered wholly inaudible by a general uproar, which proceeded chiefly from the side which he rose to support. We were told that this was due to the memory of the effect which was produced by his speech on the occasion of the previous vote.

Upon the whole, we think that the debate was of no little service to the cause of physiology in Oxford; and, when we consider how largely the majority of votes has grown since the first of the three divisions, we are glad to congratulate the university upon having shown so emphatically, that, not less than her sister, she is able to withstand the assaults of the two great enemies of learning, — ignorance and fanaticism.

THE ROYAL ASTRONOMICAL SOCIETY OF LONDON.

THIS society, the most important astronomical organization in existence holding frequent meetings, had its anniversary session on Feb. 13, on which occasion the principal event was the presentation of the gold medal to Dr. William Huggins for his spectroscopic researches, as already announced. The 'Monthly notice' which gives account of this meeting is usually the most interesting number for the year, and the present issue is not disappointing in this regard. The society, which was organized about the year 1820, is possessed of a good degree of wealth, aggregating considerably more than a hundred thousand dollars, of which about seventy thousand are pecuniarily remunerative. Not a small amount of the society's property is in the shape of astronomical and other instruments of precision, a catalogue of which is regularly published, and embraces this year a list of a hundred and twenty-one entries. The publications of the society have now reached the forty-fifth volume of 'Monthly notices,' and of the 'Memoirs' the forty-eighth. The second part of this latter volume is now in press, and is announced to contain Mr. Seabroke's fourth catalogue of micrometric measures of double stars, Professor Pritchard's determination of the relative proper motion of forty stars in the Pleiades, Mr. Knobel's observations of Mars in 1884, and two memoirs relative to the moon, — the one by Mr. Neison on the corrections required by Hansen's 'Tables,' and the other by Gogou on an inequality of long-period in its motion.

The council of the society record the loss by death, during the year, of fifteen fellows and one associate: an exceptional number of these are men of wide reputation, and the obituary records are exceptionally well written. We note only Henry George Bohn, John Henry Dallmeyer, Isaac Todhunter, Francis Diedrich Wackerbarth, Ernst Friedrich Wilhelm Klinkerfues, Marian Kowalski, and Johann Friedrich Julius Schmidt. In general, the 'Proceedings of observatories' are not more interesting than formerly; and, of the twenty-one institutions reported, a small number appear to be gradually fossilizing, while at two or three an extraordinary degree of activity is evinced. American astronomers will find slender cause for complaining at the council's "Notes on some points connected with the progress of astronomy during the past year;" for about one-half of the section of twenty-seven pages devoted to this history is occupied with the work of Americans in the advancement of this science. The important 'points' commented upon are Professor Newcomb's researches in mathematical astronomy, Professor Safford's investigation of Greenwich planetary observations, star catalogues by Dr. Gould and Dr. Grant, Dr. Backlund's investigation of the motion of Encke's comet, Dembowski's measures of double stars, Professor Pickering's work with the meridian photometer, Dr. Huggins's photography of the solar corona without an eclipse, Professor Langley's researches in atmospheric absorption, and the conclusions of the International prime-meridian conference.

At the conclusion of the anniversary meeting, Mr. Edwin Dunkin was re-elected president of the society; and Professor Adams, Professor Cayley, Dr. De la Rue, and Mr. Stone were elected vice-presidents.

JAMES CLERK MAXWELL.

THIS abridged volume will be welcomed with great pleasure by all who have enjoyed the larger work, for it puts into one's hands a *vade mecum*. The life of Maxwell is worth pondering upon; and it is a peculiarity of all that he has ever written upon science, that some minds can draw inexhaustible nourishment from his essays and letters. Many will miss portions of the larger volume; but, in return for what has been omitted, the editors have given three important letters from Clerk Maxwell to Faraday, and one of Faraday's to him. The volume also contains letters to Dr. Huggins on the structure of comets. His letter to Faraday, upon the latter's idea of lines of force, shows clearly how strongly the new conception had taken possession of his mind. In this letter he says, —

> "You have also seen that the great mystery is, not how like bodies repel and unlike attract, but how like bodies attract by gravitation. But if you can get over that difficulty, either by making gravity the residual of the two electricities or by simply admitting it, then your lines of force can 'weave a web across the sky,' and lead the stars in their courses, without any necessarily immediate connection with the objects of their attraction."

It is highly interesting to read the letters which passed between these distinguished men. It was perfectly natural for Maxwell to express his physical ideas in mathematical language; while Faraday, unversed in mathematics, could nevertheless express his conclusions in a logical shape, which were the translations into ordinary language of the results of Maxwell's equations. In one place Faraday writes, —

> "There is one thing I would be glad to ask you. When a mathematician, engaged in investigating physical actions and results, has arrived at his conclusions, may they not be expressed in common language as fully, clearly, and definitely as in mathematical formulae? If so, would it not be a great boon to such as I, to express them so, translating them out of their hieroglyphics, that we also might work upon them by experiment?"

The life of James Clerk Maxwell; with selections from his correspondence and occasional writings. By LEWIS CAMPBELL, M.A., LL.D., and WILLIAM GARNETT, M.A. New edition, abridged and revised. London, *Macmillan*, 1884. 16+421 p. 8°.

In these days of renewed interest in the establishment of physical laboratories, it is interesting to read Maxwell's views of the best method of conducting these laboratories. In a letter to Mrs. Maxwell, he says in regard to the Cavendish laboratory at Cambridge, —

"There are two parties about the professorship: one wants popular lectures, and the other cares more for experimental work. I think there should be a gradation, — popular lectures and rough experiments for the masses, real experiments for real students, and laborious experiments for first-rate men."

Rarely has the true solution of the problem of the proper course in the direction of a laboratory been more clearly stated.

Many who know nothing of the nature of the studies to which Maxwell devoted his life, will read his life, and find it a fascinating one. The philosopher will ponder over the views of the structure of the universe, and Maxwell's endeavor to do his duty in a world some of whose mysteries he set himself to discover. The physicist will find it easier to read the treatise on heat, and the treatise on electricity and magnetism, by becoming better acquainted with the habits of thought of Maxwell as they are revealed by his own letters in this little volume. The devout Christian will find in Maxwell an exemplar to whom he can point with unanswerable words as an illustration of the satisfying power of the Christian faith to a mind which has had few equals in the history of the world, and which, nevertheless, clung to the Christian religion as the only satisfying thing in the end.

THE PART PLAYED BY THE CELL IN LIVING ORGANISMS.

LIKE most other new doctrines, the cellular theory has been given too wide an interpretation. Within the last few years, botanical research has proved that the essential living part, the protoplasm, is often united by slender threads passing from cell to cell. A similar connection has also been demonstrated in certain animal organs. Nevertheless, 'cells' remain actual facts, and very important facts, of which the biologist has to take account. The cellular theory may be modified in detail, but it will remain true in essentials. With regard to certain cells, even in the highest animals, as the amoeba-like corpuscles which creep all over our own bodies in the lymph-channels, and play an important part in the regeneration of injured tissues, it is certainly true, even in its most extreme form. At this critical epoch in its history, a brief account of the development of the cell-doctrine may be of interest. We condense it from the pages of Canon Carnoy.

Robert Hooke (1665) first applied the word 'cell' in describing the structure of plants. He did not, however, regard cells as separate pieces of living matter, but compared them to cavities in a continuous mass, like the cells of a honeycomb. Malpighi (1675) recognized that vegetable cells were distinct, apposed, closed sacs. Leeuwenhoek, in his letters to the Royal society of London (1680–95), called especial attention to the cell-membrane or envelope. From this time, for about one hundred years, vegetable cells (animal being unknown) were regarded as little bladders filled with a homogeneous liquid.

The next advance was made in 1781, when Fontana described and figured within some cells an 'oviform body provided in the centre with a spot.' This earliest observation of the cell-nucleus remained practically unheeded for fifty years, and then R. Brown of Oxford confirmed and greatly extended it. He first demonstrated that the nucleus was a normal and usual constituent of vegetable cells. The 'spot' inside the nucleus seen by Fontana, and now known as the *nucleolus*, was rediscovered by Valentin in 1836. At this epoch, therefore, the *cell* was defined as "a vesicle with a solid envelope, containing liquid in which a nucleus with its nucleolus floated." Starch grains, chlorophyl bodies, and crystals had also been seen in various cells.

The next step forward was the recognition of cells as independent individuals, or 'elementary organisms.' Turpin and Mirbel promulgated this view about 1826; but it was Schleiden's 'Grundzüge der wissenschaftlichen botanik' (1842) that led to any general acceptance of it by scientific men. Since then, Schwann, Max Schultze, Brücke, and many others, have firmly established it.

Meanwhile, the relation of cells to the large plants in which they were found, was being studied. Malpighi and Leeuwenhoek both believed that such plants were essentially made up of juxtaposed cells. Schleiden and others, especially Hugo von Mohl (1827), finally demonstrated that vegetable tissues, as a whole, were but aggregates of more or less modified cells, which had a common origin, and were all at first alike, but often became greatly altered in the growth and development of the plant.

La biologie cellulaire: étude comparée de la cellule dans les deux regnes. Par le Chanoine J. B. CARNOY, professeur à l'université catholique de Louvain. Lierre, *Joseph Van In et cie.*

About 1830 the cell-doctrine was accepted, so far as concerned the vegetable kingdom. That it was also applicable to animals, was stated by Dutrochet in 1824; but it remained for Schwann to prove in his classical treatise (1839) the correctness of this thesis. From that time the cellular theory may be regarded as definitely established. Its extension to the explanation of certain pathological processes by Goodsir (1845) and Virchow (1859) was a noteworthy advance.

All this time the definition of the cell, accepted at the time of Valentin's work, was undergoing modification. The protoplasm was discovered, and its fundamental importance recognized. Bit by bit the essential structure of cells was simplified, until now the term denotes nothing but an independent particle of protoplasm. This particle may have, and often has, a nucleus in it, and a cell-wall around it; but both may be absent, and the tiny mass live and grow and multiply. Such modifications, in our conceptions as to what parts are necessary to the construction of a cell, do not, however, in any way essentially alter the cell-doctrine: it still remains a fundamental truth, the basis of all morphology and physiology.

Of late years a vast number of important papers have appeared, dealing with the structure and the properties of cells. They are scattered over the pages of many journals, and written in many languages; and the time had come for some one to collect and unify them. A good summary of the more important results of the work of the past twenty years, and a bibliography, aiding those desiring more detailed information to find it in original sources, was a necessity. Canon Carnoy undertook this task; and, so far as the present fascicule of his treatise on the 'Cellular biology' goes, has performed it well. The instalment published contains two hundred and seventy-one pages, of which, however, only the final hundred deal directly with cells. The introductory pages contain an exposition of the objects and methods of education, which we heartily commend to all teachers of natural history; also directions in histological technique, which, for students of general biology, are more useful than those in any text-book of microscopy with which we are acquainted.

The subjects discussed in the final hundred pages are as follows: discovery of the cell and of its parts; elementary organisms; the cellular biology; protoplasm; the properties of living matter; the general structure of the cell, and its newer definitions; the structure and general composition of protoplasm and nucleus; the general laws of the cell; the structure and composition of the nucleus in detail. The last topic occupies more than sixty pages. and is of great value as bringing together in convenient form the main results of the many researches on nuclei made during the last ten years.

An important and gratifying feature of the book is that its illustrations are not only good, but new. It is difficult to express fully our gratitude for this: those who have been wearied by seeing the same veteran woodcuts dragged out once more for duty in each new text-book, will, however, appreciate the gladness with which we greet these new, and in most cases better ones.

While we heartily commend Canon Carnoy's book for its scientific merits, we think that it has another claim to the attention of all who are interested in the progress of human thought: it marks the close of an epoch. Written by a professor in a Catholic university, in a Catholic country, and utilizing and accepting as it does the results attained by the best biological workers and thinkers independently of all theological prejudice, it is a sign, among many, that modern biology has won its battle. There will still be occasional echoes of the struggle, and we may for some time to come meet such instances of persecution as that to which Professor Woodrow was recently subjected; but the war is over. The religious world in general recognizes daily with greater clearness that science is not necessarily irreligious; and that the conviction that our universe has been developed and is governed in accordance with immutable laws, is compatible with belief in an all-wise Law-giver.

LANGLEY'S WORK ON MOUNT WHITNEY.

FROM a scientific point of view, the 'Report of the Mount Whitney expedition of 1881' is unquestionably one of the most important volumes which has ever been issued by our government. It presents fully and clearly, not only the observations made upon the mountain, with their results, but also much of the preliminary work and discussion which showed the need of such an expedition, together with a description of the ingenious and delicate apparatus devised by Professor Langley for the investigation.

Researches on the solar heat, and its absorption by the earth's atmosphere. A report on the Mount Whitney expedition. By Prof. S. P. LANGLEY. Washington, *Government*, 1884. (Prof. papers U. S. signal serv., xv.) 242 p., illustr., 21 pl., map. 4°.

To a certain extent, the principal results have already been given in various papers read before the National academy of sciences, and printed more or less fully in the different scientific journals; but we now have, for the first time, the details of the observations and computations from which the results have been derived, and are put in possession of the facts necessary to a due appreciation of their weight.

The first of the twenty-one chapters of which the report consists, is occupied with the preliminary observations at Allegheny during 1880 and 1881, — observations which brought out clearly the fallacy of most of the methods and conclusions previously adopted, and the necessity of a careful series of observations at some elevated station.

The second chapter contains an account of the organization of the expedition under the auspices of the signal-service, and gives the story of the journey, with a description of the stations. It is made quite clear that Mount Whitney is a station every way adapted to the purposes for which it was selected; and every one interested in science will most sincerely join in the author's hope "that something more than a mere ordinary meteorological station will be erected here, and that the almost unequalled advantages of this site will be developed by the government."

The third chapter contains a brief historical summary of the actinometric work done by various observers previous to 1880. We miss in it, however, any allusion to the labors of Secchi, Rosetti, and Waterston.

The next five chapters are devoted to the pyrheliometric and actinometric observations made by the expedition, with all necessary details as to the apparatus and methods of reduction. Professor Langley condemns the pyrheliometer of Pouillet as liable to give a very inaccurate determination of the quantity of heat actually brought by a given sunbeam under given circumstances; and he appears to consider the globe actinometer of Violle as, on the whole, the best when the constants of the instrument have been determined with sufficient care. The summary of results in chapter ix. makes it very clear, however, that the mere inaccuracies of observation are not so prejudicial to the satisfactory determination of the 'solar constant' as the use, in the reductions, of the fallacious assumption that the amount of radiant energy transmitted through an imperfectly transparent medium is given by the long-accepted formula, $C = Ea^{\epsilon}$, in which E is the 'solar constant,' a a constant 'coefficient of transmission,' and ϵ the 'thickness' of the air-stratum through which the rays penetrate. To bring out this fallacy is one of the author's main objects; and he sets it in a striking light by certain comparisons, given on pp. 69 and 119, between the results obtained at Lone Pine and at Mountain Camp, eight thousand feet higher. We note, however, that, by a sort of impish perversity of typographical luck, 1.797 is printed for 1.707 on the ninth line of p. 119, making the printed figures egregiously contradictory of the conclusions asserted in the text.

The fallacy consists in neglecting the fact that the solar radiation is not homogeneous, and in assuming, that, while such is the fact, the formula given above is applicable, provided one determines with care a sort of mean value for a by the comparison of observations made at different altitudes of the sun. In chapter x. the author discusses the matter fully, and shows mathematically that *values of the solar constant, obtained by reducing, according to this formula, any possible actual observations, will inevitably be too small, and probably very much too small.*

Chapters xi., xii., and xiii. are taken up with the description of the special apparatus devised by the author to meet the difficulty, and with an account of the observations made with the spectrobolometer at Mount Whitney and Allegheny; other chapters are devoted to the 'transmissibility' of our atmosphere for light, and to sky and nocturnal radiation; and others yet, include an interesting summary and discussion of the hygrometric and barometric observations. The report proper closes with a general summary of results. As regards the 'solar constant' itself, the author's conclusion is, that "at the earth's mean distance, in the absence of its absorbing atmosphere, the solar rays would raise one gram of water *three* degrees Centigrade per minute for each normally exposed centimetre of its surface." According to this, the 'solar constant' is three (small) calories (gram degrees) per minute per square centimetre, — equivalent, of course, to thirty large calories (kilogram degrees) per minute per square metre. The hitherto received values range from twenty to twenty-five. Other results of great importance are also indicated, relating to the wave-length of 'dark-heat,' the theory of the maintenance of the earth's temperature by its overlying atmosphere, the amount of absorption by this atmosphere, and a number of other related subjects. We have not room to quote them, and they would better be read in their connection.

There are also three appendices, — the first relating to the reduction of the psychrometer observations, which, at the summit of the mountain, show certain considerable discordances; the second, on the experimental determination of wave-lengths in the invisible prismatic spectrum, — a paper already published elsewhere, but most appropriately reprinted in this connection; and, finally, an investigation of the effect of convection-currents upon the loss or gain of temperature by a thermometer-bulb.

There can be no question that Professor Langley's exposure of the fallacy of the earlier methods of investigating the solar radiation, and his invention of the spectrobolometer, will always be recognized as an epoch in the history of the subject; and in the volume before us we have the best available summing-up of the matter.

It would be unjust to close this notice without an allusion to a fact which is well and gracefully stated in Gen. Hazen's brief preface: "It should be said that the aid given to Professor Langley [by the signal-service], which he so gracefully acknowledges in the text, was necessarily limited. A large part of the expense of the outfit was generously borne by a friend of the Allegheny observatory." To this anonymous friend, as well as to the signal-service and to Professor Langley himself, the thanks of all who are interested in science are due, and are hereby returned.

NOTES AND NEWS.

The legislature of Wisconsin has appropriated a hundred and ninety thousand dollars to the University of Wisconsin, for rebuilding the science laboratories destroyed by fire on Dec. 1, 1884. The new buildings will consist of a chemical laboratory, a machine-shop, and a building for the departments of physics, engineering, geology, and zoölogy. All are to be fire-proof, or, more accurately, 'slow-burning,' buildings; and the heating-apparatus for all is to be placed in a separate structure. In addition to the above-named sum, the insurance on the former building, amounting to some forty thousand dollars, is appropriated for refitting the departments with necessary furniture and apparatus for immediate use. No appropriation for cabinets, etc., was urged, as the next legislature will meet before the completion of the new building. It is proposed to push the construction of the chemical laboratory and machine-shop as rapidly as possible. Since items have appeared, asserting that the Lapham herbarium was destroyed, it may be stated that the herbarium was not in Science hall, and is consequently intact.

— In their report on Edison's autographic telegraph, the examiners of telegraphic apparatus at the Philadelphia electrical exhibition write, "It was not set up in such manner that its construction or mode of operation could be examined, and we are therefore unable to report upon it. It may, perhaps, be proper to say that the autographic system for the transmission of communications in facsimile would seem to afford one of the most promising fields for the labors of future improvers of the telegraph. It is apparently in this direction, if any, that we must look for the future solution of the problem of cheap telegraphy. It will be readily understood that if an efficient system were invented by which the original message, as written by the sender, could be placed in a machine, and a facsimile of it instantly produced by the action of electricity at a distant station, and this by automatic machinery without the intervention of human hands, the actual cost of performing the service would be but the merest trifle. Yet there is apparently no obstacle in the way of obtaining this result, which we may not hope to see overcome sooner or later by the genius and perseverance of our inventors."

— The Leander McCormick observatory of the University of Virginia was inaugurated on April 13; the ceremonies taking place in the public hall of the institution, and Professor Asaph Hall of the naval observatory, Washington, delivering the address. The principal instrument is the great Clark refractor of twenty-six inches' aperture. The observatory has a house adjoining for the director, Professor Stone, and is possessed of a considerable endowment fund, the gift of Mr. W. H. Vanderbilt of New York.

—Capt. Thompson of the schooner R. Bowers reports that on June 4, 1884, in latitude 42° 46′ north, longitude 60° 47′ west, a sealed bottle, inside of which was placed a record of their voyage, was thrown overboard. The bottle, with record, was picked up on July 15, 1884, at Little Dover Bay, east point of Nova Scotia.

— A pamphlet has been issued by Dr. John S. Billings, the secretary-general of the International medical congress, to be held in Washington in 1887, giving the rules for the congress, and a provisional list of officers.

— The circular of the summer school of languages at Amherst for the coming session, exhibits an enlargement of the methods and aims of the school, and an increase in the number of subjects taught and of teachers demanded, which, a few years back, any one would have been thought over-sanguine to predict. The growth of the school seems to indicate plainly that it has created a demand for itself, and that its management is meeting the necessities of the case in a satisfactory manner. Professor Montague, of the department of modern languages in Amherst college, is the director of the school: and he has the immediate co-operation, in German, of Professor Zuellig, now an instructor at Princeton; in French, of Professor Bernard of Boston; in Latin, of Professor Johnson of Lehigh university; and in Hebrew, of the well-known specialist, Dr. Haley. Thirteen other instructors in language are also announced; and the generosity of the officers of the college in

making its cabinets, museums, and library collections available to the students of the summer school, is worthy of note.

— In commenting on the automatic chemical telegraph, the committee on telegraph apparatus at the Philadelphia exhibition says that this system was at one time in commercial use to a considerable extent in this country, but has been abandoned for reasons probably due more to peculiarities in the commercial requirements of American telegraphy than to any inherent difficulties in the operation of the mechanism itself. The automatic method of transmission, although full of promise, has in almost every instance failed to realize the expectations of its advocates as a substitute for the ordinary process of manual transmission. This difficulty, whatever it may be, is inherent in the principle itself, and is not properly chargeable to defects in the operation of the apparatus.

— The *Auk* for January contains the preliminary report of the committee on bird-migration, of the Ornithological union, from which it appears that observing-stations are now established in every state and territory in the Union, except Nevada. Returns have been received from over one thousand observers, who are usually, not ornithologists, but, as a rule, intelligent farmers, who know only the very commonest birds. The most eastern station is at St. John, Newfoundland; the most northern, at Belle Isle, off Labrador; and the most southern, at Sombrero Key, Fla. Reports have also come from many points on the Pacific, and even from as far north as Point Barrow, Alaska. The amount of information so far received is so comparatively meagre, that it is impossible to generalize as yet; but the various observers are working with great interest in the matter, so that it cannot be long before many valuable generalizations can be drawn from the data which are so rapidly coming in.

— The third lecture before the San Diego society of natural history was on the Sudan, delivered by Stuart Stanly; and the visit of Dr. Farlow was improved by engaging him to give the fourth.

— According to the Journal of the Iron and steel institute, large deposits of iron ore have been discovered in Cuba, the extent of which will cause the island to take rank with other countries as a source of supply of the raw material for iron-making. An American mining engineer states that he is familiar with most of the rich fields in the United States and in Europe, but that he has never seen any like those of Cuba. He adds that he has seen veins of iron ore, but that there are on the surface immense deposits, varying in thickness from ten to fifty yards, mostly in blocks of from two to twenty tons' weight. At one place he found by actual measurement that there must be present about 1,837,450,000 cubic yards of ore. This deposit is situated only about half a mile from the sea, where a good harbor can be opened to ship the ore. Farther in the interior there is another large deposit.

— The Royal society of New South Wales offers its medal and twenty-five pounds for the best communication (provided it be of sufficient merit) containing the result of original research or observation upon each of the following subjects: — to be sent in not later than May 1, 1886, on the chemistry of the Australian gums and resins; on the tin deposits of New South Wales; on the iron-ore deposits of New South Wales; list of the marine fauna of Port Jackson, with descriptive notes as to habits, distribution, etc.: to be sent in not later than May 1, 1887, on the silver-ore deposits of New South Wales; origin and mode of occurrence of gold-bearing veins and of the associated minerals; influence of the Australian climate in producing modifications of diseases; on the Infusoria peculiar to Australia.

— The meteorological summary for February, 1885, at San Diego, Cal., gives the mean daily temperature at 55.9°; the highest temperature, 76°; the lowest temperature, 37.6°. The mean daily relative humidity was 77.7, with only .01 of an inch of precipitation, against 9.05 inches of precipitation in February, 1884.

— Rev. E. L. Greene, of the University of California at Berkeley, intends making a botanical trip in April to the Guadaloupe and the Cerros Islands, off Lower California.

— The applications for space in the Inventions exhibition at South Kensington have been enormous. If all the applications had been granted, it would have required an area six times as large as Hyde Park to contain the exhibits; yet the inventions are confined to the last twenty-three years, and the music, with the exception of the historical collection, restricted to this century. Steam engines and boilers have the largest share of space; electricity, naval architecture, and mining and metallurgy, having the next.

— The total distance run by the cars on the Brighton (England) electric railway during the first six months of its existence was fifteen thousand six hundred miles. Two hundred thousand passengers were carried, at an expense of five cents per mile.

— It is reported that the experiment is to be tried in Berlin of running the street-cars by electricity. Storage-batteries of the form supplied by the Electric-power company of London will be employed.

— The Messrs. Orcutt of San Diego, Cal., intend penetrating the Lower Californian peninsula as far as possible by wagon this spring, with the object of investigating its flora.

— Mr. D. S. Smart, in a paper recently presented to the British institution of civil engineers, describes recent British practice in steam-boiler construction. He states that 'low,' 'soft,' or 'mild' steel, which has the valuable qualities of iron without its defects, is now extensively used for this work. It is made usually from thirty to thirty-six per cent stronger than boiler-iron, and is superior, when well made, in ductility. Some variation in this last respect has led to considerable distrust of the metal; but this distrust has been quite often due to unfamiliarity, on the part of users, with the nature of the material, and

with the proper methods of manipulating it. Some brands are found to weld like iron, while others will not weld, and are brittle. No accident of serious character has yet occurred, however, to any steel boiler, so far as reported. It is not yet fully ascertained to what extent deterioration may affect the safety of steel boilers. It is anticipated, however, that the metal is likely to prove more satisfactory in this respect than iron. Steel rivets are used to some extent, and their use is continually increasing. More care is requisite in their working than is demanded in the use of iron rivets. It is desirable that all parts of the boiler, and, as far as possible, of its appurtenances, should be made of steel, in order that voltaic action and consequent corrosion may be avoided. Steel plates are usually drilled, instead of being punched, as it is found that steel is more liable to injury by punching than iron.

— The seventh volume of the *Bulletin* of the National academy of sciences, of Cordoba, is entirely occupied with a monograph on Staphylinidae, or rove-beetles, of Buenos Ayres, by Arribálzaga, which is completed with the third number, just received, making altogether nearly four hundred pages.

— The Portuguese explorer, Serpa Pinto, has undertaken a fresh expedition into central Africa. He intends to start from Mozambique in the direction of Lake Tanganyika, crossing the Muropue country, where he hopes to meet with the Portuguese Kongo expedition.

— A French commission has left Marseilles to further the Roubaire scheme of an inland sea in the African desert. The destination of the commission is Gabes, where a harbor is to be made as an outlet for the connecting canal.

— Town councillor Helm of Dantzig has given his collection of three thousand specimens of amber insects, and seven thousand beetles, to the West-Prussian provincial museum, on condition that they are left in his own house during his lifetime.

— The British steamship Chicago, Capt. Jones, reports that on March 25, in 41° 14′ north, 62° 10′ west, at two P.M., a very heavy vapor was observed on the surface of the sea; and distributed about in this vapor were hundreds of miniature water-spouts, rising about twenty feet high. Immediately over this part of the water was a large, black, arched cloud. The barometer at the time was 30.09, air 48°, water 61°; winds moderate from the southward.

— In the April number of the *American journal of mathematics*, the contributors, seven in all, hail, two from Baltimore, and one each from Paris, the Royal academy at Woolwich, Toronto, Bremen, and Porto.

— Among recent deaths we note the following: Major F. J. Sidney Parry, one of the oldest members of the Entomological society of London, in The Warren, Bushey Heath, Feb. 1; J. A. Serret, mathematician, at Paris, March 3; Nicolas Sewertzow, zoölogist, Feb. 9; Gen. G. von Helmersen, geologist, member of the Royal academy of sciences since 1844, at St. Petersburg, in his eighty-third year; Geoffrey Nevill, formerly assistant superintendent of the Indian museum at Calcutta, at Davos, Feb. 10; Dr. Ernst Erhard Schmid, professor of mineralogy in the university of Jena, at Jena, Feb. 16, in his seventy-first year; Carl Theodore Ernst von Siebold, professor of zoölogy in the university of Munich, at the age of eighty.

— At a meeting of the Society of chemical industry, held in Glasgow on March 3, Mr. James Murrie read a paper on the processes employed in Italy for the extraction of oils, etc., from bituminous rocks in that country. At the outset he said that the Italian government had given great facilities for developing the internal resources of the country, particularly with regard to carbonaceous deposits. There was a general belief that a belt of oil passed through the Apennines in the direction of Roumania, and curved out near Bucharest. There was, however, really no such thing as an oil-belt in Italy. The deposit of oil and bituminous rocks, which had received the greatest attention, was situated in a spur of the Apennines known as the Abruzzo, in the province of Chieti, twenty miles inland from the town of Pescara, on the Adriatic. The indications of bitumen occurred in the form of asphaltic rock, found in a superficial deposit on the slope of the mountain. Going on to speak of the extraction and manufacture of oil from the rock, Mr. Murrie remarked that about twenty companies had started operations for the purpose of utilizing this mineral. These ventures had invariably turned out failures; the cost of refining it being too high, and the density of the oil produced too great, to allow of its being used for burning-purposes. So far as his observation went, the only uses it could be put to were in street-lighting, for mining-purposes, and in the preparation of lubricating-oils.

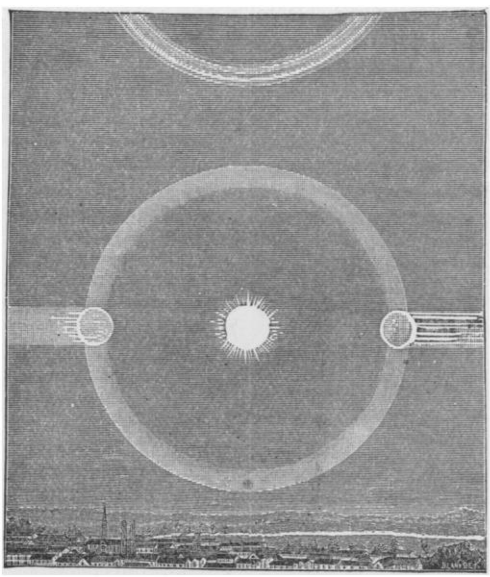
— In addition to the numerous uses to which the wonderful network of Parisian sewers has already been put, we learn from *La lumière électrique* that the lines of telephone-wires are now being placed upon these underground walls. This is simply following the example of the telegraph companies, who did the same in 1880. The sewers also contain two large water-pipes, — one for household, the other for sprinkling purposes; and, besides, a pneumatic tube used for the transmission of messages, and a smaller pipe which transmits the air-pressure for the system of pneumatic clocks distributed throughout Paris.

— Mr. E. E. H. Francis recently read a paper at the London chemical society in which he showed that filter-paper, ordinarily so weak, can be rendered tough, and at the same time pervious to liquids, by immersing it in nitric acid of relative density 1.42, then washing it in water. The product is different from parchment paper made with sulphuric acid, and it can be washed and rubbed like a piece of linen. It contracts in size under the treatment, and undergoes a slight decrease of weight; the nitrogen being removed, and the ash diminished.

— The king of the Belgians has planned an International geographical society, and has summoned Milne-Edwards of Paris to be his helper therein.

— According to the committee on telegraph apparatus at the Philadelphia electrical exhibition, the possibility of employing a single conductor for the simultaneous transmission of two or more sets of telegraphic signals appears to have originated with Moses G. Farmer of Boston, Mass., about the year 1852. Mr. Farmer attached to each end of the line a rapidly revolving commutator or distributer. The two distributers, when caused to revolve synchronously and in unison, served to bring the line successively and simultaneously into connection with a corresponding series of short branches at each terminus, in each of which branches ordinary telegraphic apparatus was inserted and operated in the usual manner. Thus the current through each pair of corresponding branches at either station, while apparently continuous, actually consisted of intermittent but rapidly recurring synchronous pulsations. Mr. Farmer successfully experimented, upon a small scale, upon the wires of the municipal telegraphic lines of Boston in 1852. Nothing of permanent value, however, resulted from the experiments at that date, the difficulty of maintaining the absolute synchronism required for operating for any considerable length of time being apparently insuperable.

— *L'Astronomie* reports a most remarkable halo seen by M. D. Luzet on the 17th of January last at Orleans, France. There were no clouds in the sky, simply a light mist, and the temperature was — 1° C. At 12.40 P.M. a very brilliant circle, with a radius of 22°, appeared around the sun; and, at the two extremities of the horizontal diameter of this circle, two white spots were formed, which, gradually increasing in intensity, became very brilliant at 12.55. Above, and not touching the circle, was a rainbow, which gradually faded out at its extremities into the blue sky. The red of this bow was outside, the violet within, and the brightness and distinctness of the tints were very marked.



HALO SEEN AT ORLEANS, FRANCE.

— The recent fire in the capitol at Trenton, N.J., inflicted considerable loss on the geological collections of the state. The suites of typical rocks from the several formations, and large collections of iron ores, clays, marls, and soils, were all lost; and some old state maps, now out of print, were destroyed. The old collection of H. D. Rogers was lost; that of Dr. Kitchell was saved. Fortunately, a large number of selected representative specimens of rocks, ores, woods, etc., escaped by being in the state exhibit now at New Orleans; and while the loss, as a whole, is a serious one, it is not irreparable. In the continued prosecution of the state survey, it will be possible in time to make a fuller and more representative collection than that which is destroyed. It is to be hoped that the new rooms, which we understand are to be provided for the museum, will be of safer construction, and, if necessary, isolated to make them more secure.

— The *Echo du Japan* reports the arrival in Japan, at the beginning of the year, of Joseph Martin, a French traveller, who had just been exploring the parts of Siberia hitherto very little known. His principal journey was from the Lena to the Amoor, across the Stanowai chain of mountains. During his explorations he was able to make geographical and geological collections, which are intended for the Paris museums. In consequence of hardships endured on the journey, two of his native followers died, and one lost his reason.

— Mr. Ellery of the Melbourne observatory has taken the necessary steps toward the organization of a small expedition to the southern coast of the north island of New Zealand, in the coming September, to observe the total eclipse of the sun, which occurs on the 8th of that month. The track of the line of total eclipse lies almost wholly in the South Pacific Ocean, and New Zealand is the only land crossed by it; the duration of totality lasting about two minutes at the spot most favorably located for the observation.

— The legislature of New York has passed an appropriation of twenty-five thousand dollars for the State survey.

— A bill has passed the Wisconsin legislature providing for the education of deaf-mutes. Hitherto there has been no special provision for their instruction.

— The topographical map of New Jersey, to which attention has been called already several times, has now advanced to the point of issuing six sheets in all. They are fine pieces of work, of which the state may justly be proud. Eleven more sheets remain to be done.

— We neglected to state in our last that the facsimile of the map by General Gordon, of the route from Suakin to Berber, was published by Edward Stanford, 55 Charing Cross, London.

SCIENCE.

SUPPLEMENT TO No. 115, FRIDAY, APRIL 17, 1885.

REFORMATION OF SCIENTIFIC LEGISLATION.

Among the propositions floating in men's minds with regard to the re-organization of the scientific and economical works of the federal government are several that can easily be disposed of as impracticable or otherwise objectionable. It will be necessary to enumerate and dispose of a few of these before suggesting any satisfactory solution of this important question.

1. The proposition to put the conduct of the specially scientific work, such as geology, geodesy, meteorology, astronomy, into the hands of the Smithsonian institution. This institution is supported wholly by the income of trust-funds dedicated to a specific purpose by James Smithson, for whom the government accepted the position of executor; and the government cannot legally impose upon this institution any labors or expenses not warranted by the terms of Smithson's will, as interpreted by the highest legal authority in the land. The proper interpretation of the intent of the testator has already been so clearly settled and widely accepted, that it is incredible that now, in the full tide of the prosecution of his desires, the government, as executor, will attempt to divert his funds to other uses. But it will be said, the United States has merely to appropriate additional funds to enable the institution to carry out the proposed increase in its work and responsibility. This seems plausible; and if carried into effect, although it would seem to add these duties to those of the present secretary of the institution, yet it need not necessarily do so: in fact, it is not to be supposed that the United-States government would put the conduct of all its public works into the hands of one man. Probably the authors of this plan had in mind the regents of the Smithsonian institution, and not the secretary, as the body to which the government should assign its scientific work: in other words, to the regents of the Smithsonian should be confided the question of the conduct both of that institution and of all our public works. It is argued in favor of this, that we have here one institution of a high character, managed by men already organized and recognized, and that the transfer of others to them would be a simple matter. It already has charge of not only the Smithsonian institution proper, but of the national museum, fish-commission, bureau of ethnology, the care of the collections made by geological surveys — and why not of every thing else? But there are many other organizations under government auspices, composed of men who stand ready to undertake great trusts; and who will maintain that the regents have any special qualifications over others? By the law of 1846, the board of regents consists of eight persons chosen from the legislative and executive bodies, and six other persons not members of congress (two of them resident in Washington, and the other four from distant states). Among the twelve persons now constituting the board of regents, we find only one person that can be called a scientific man, — Professor Asa Gray of Cambridge. From the beginning, the policy of the regents has been to appoint a scientific and practical man as secretary, or superintendent, or director of the institution, who is, in fact, simply an autocrat, although legally he is the executive officer of the board of regents. Under this arrangement, various branches of activity have prospered, such as the library, the museum, the departments of exchanges, of publications, of meteorology, mineralogy, anthropology, etc.; and these departments have grown to be large divisions of work. The work of the fish-commission seems never to have been carried on at the expense of the Smithsonian, but was entirely extra work fostered by the regents, in that Professor Baird was allowed to give a portion of his time to it, while the expenses were borne by special appropriations from congress: we may therefore look upon the U. S. fish-commission, which was established by law in 1871, as a scientific and practical institution, fostered by the Smithsonian, but having an independent existence of its own. The policy of the

institution has been little by little to secure an independent existence for each of its varied departments, so that the trust-funds at its disposal could be utilized for new fields of work, — a policy fully justified by the intensely practical value of its labors in the increase and diffusion of knowledge. Thus it happened, that, as soon as the library of congress had an organization and income sufficient to warrant the step, the Smithsonian transferred to its care its large scientific library, and relinquished the idea of maintaining a separate library of its own. Similarly, in 1874, the signal-office weather-bureau having apparently a separate existence of its own, the institution transferred to it its great collection of meteorological data and correspondence, thus relinquishing its own division of work in that department. More recently its system of international exchanges, as also its museum and its mineralogical and anthropological collections, have been recognized as worthy of special encouragement by the government, and have been either made into separate departments, or partially transferred to the geological survey, the national museum, etc.

In a hundred ways the devoted chiefs Henry and Baird have known how to stimulate and co-operate in the increase and diffusion of knowledge. It is now proposed to reverse this process by which separate institutions have grown up as children under the Smithsonian, and have gone out from it when able to stand alone, and to send them all back, with others, to the fostering care of the parent. Evidently, however, some new plan of organization must be adopted before these full-grown institutions can be comfortably housed together. The secretaries, Professors Henry and Baird, have neither of them ever indicated their ability, willingness, or desire to be burdened with the responsibility of so many great organizations; and the regents, composed of statesmen and the executive officers of the government, are not the proper persons to whom to commit these important interests, involving the annual expenditure of from five to twenty million dollars, and in respect to which the expenses of the present administration of the Smithsonian, or the responsibility of its present regents, are quite insignificant. Some satisfactory co-ordination of government work is certainly desirable, — such a co-operation of all departments as has been especially shown by the surgeon-general's office, the signal-office, the navy and the interior departments, in their relations with the Smithsonian. But to put all under the present board of regents of the Smithsonian, who are merely the advisers of our government as executor of Smithson's will, is not a very dignified proceeding, and is utterly contrary to the provisions and spirit of the federal constitution, according to which the executive power is vested in the president, to whom is allowed a cabinet officer in charge of each of the executive departments; and all disbursements of public moneys must take place through and with the authority of some one of these executive officers.

2. A second proposition has been thrown out by the committee appointed by the president of the National academy of sciences, Prof. O. C. Marsh. This committee, although consisting of members of the academy, does not speak with the authority of that academy as such, as its views were never submitted to, or ratified by, the academy. On the one previous occasion, when congress asked advice of the academy in a matter of legislation concerning the consolidation of surveys, the report of the committee was discussed, amended, and adopted by the academy as a whole, as, indeed, the importance of the subject warranted; and the recommendation of the academy was sufficiently mature to command the respect of all. In the present case this has not been done; and whatever aid or suggestion this present committee has given, is therefore to be credited to them individually, and has not the weight of the authority of the academy as such. The committee, after being shorn of two of its best members, has submitted two distinct propositions, both of which are, they say, 'the general sentiment and wish of men of science,' although they give us no hint as to how they discovered or drew out such expressions of opinion. Both their propositions embody the general feature of the collection of the scientific and other bureaus under one general authority, to be recognized as responsible for and controlling generally the scientific operations of the government. Among the definite forms that might be given to such central authority, they specify two ; namely, —

(*A*) The establishment of a new special department of science as one of the principal branches of the executive department of the government (see article ii. of the federal constitution), to which shall be given the direction and control of all the purely scientific work of the government; and which work should be cultivated, they say, because scientific investigation promotes that general welfare the attainment of which was the object of the constitution.

(*B*) The transfer of all such work or bureaus as now exist to some one of the present executive

departments, in which department four bureaus should be organized to carry on the four principal classes of work: namely, 1. Geodesy, topography, and hydrography; 2. Geology; 3. Meteorology; 4. Physical standards of weights and measures. In order to assist the secretary in charge of the department to which these works are to be transferred, and under whom the four bureaus are to labor, the committee proposes the formation of a permanent commission, which is not charged with any administrative responsibility, but which shall be attached to the office of the secretary of the selected department, and, under his presidency, shall exercise a general control over the work of the four bureaus, and shall have charge and custody of all the archives, apparatus, and other things appertaining to their work. The commissioners are to receive a salary; and, if any of the four bureau officers spend money contrary to their recommendation, the commission shall notify the proper authorities. In general, the commission is to annually examine, improve, and approve the plans of work and estimates of the four bureaus, but is not charged with purely administrative responsibility: it recommends to the secretary or chief of the department whatever is necessary to the best work of the four bureaus, but has no power to enforce its own recommendations except by remonstrance to the auditor against payment of funds. The commission shall, it is suggested, consist of the secretary, the heads of the four bureaus, six officers of the navy and army, two civilian scientific men, and the representatives of the Smithsonian institution and the national academy, — fifteen in all; viz., one statesman, six military officers, four bureau officials, two scientific men, and two academicians. Presumably it is contemplated that all shall be chosen by the president or the secretary.

This second proposition of the committee of academicians we have given somewhat at length; and, if we have not misunderstood it, there is in the proposed advisory commission a want of strength, and absence of personal responsibility, a liability that science will be in the small minority, — a cumbersome number of persons, such that certainly all of them, or even a majority, will never enter into the merits of the numerous difficult scientific questions that will be laid before them. The consequence will be, that the whole commission will simply approve the recommendations of its own sub-committees, and thus, after all, the conduct of the four bureaus will be entirely in the hands of these bureaus themselves. We can easily grant that the transfer to one department, and the organization of four bureaus under its secretary, may be a great step towards economy, harmony, and efficiency: but the appointment of an irresponsible commission as advisory to the secretary, who is under more or less obligation to carry out its suggestions, on the one hand gives the fifth wheel to the coach, and on the other hand relieves both the secretary and the superintendents of the four bureaus of all personal responsibility; so that if any thing goes wrong, and congress should appoint a committee of investigation, the report must necessarily be that no one is to blame. This arrangement is inferior to that by which the people hold congress, and congress holds the secretary, while he holds the four bureau officers, to a strict personal responsibility; while each has perfect liberty to call in such advice as he feels in need of.

We have here three propositions. The important general feature of them all is that of consolidation, unification, and systematization of a certain class of government works, either under the Smithsonian, or under a new executive department, or under some existing department. Abstractly such consolidation appears desirable, it certainly pleases the mind of a systematic person; but whether it will result in the greatest good, for the greatest number, is a question that needs consideration, not so much from an idealistic stand-point as from the side of statistics, experience, and history. Can it be shown, from the experience of nations or smaller corporations, that the combination under one department of such diverse matters is really a step in advance? First of all, what are the diverse interests whose welfare we propose to secure? Only a partial exhibit of government work has been given in the act under which the commission is now proceeding, or in the statements that have been made before it, which specify only the signal-service, geological survey, coast and geodetic survey, and the hydrographic office of the navy. The very first act of the commissioners, in their letter to the president of the national academy, is to call attention to the fact that the preparation of their report involves nothing less than an investigation of four important branches of our government, all scientific in their character, and invites attention to the question, "In what way can these four scientific branches be best co-ordinated?" If such coordination on this smaller scale ever be accomplished with good results, it will be an argument for the application of the same principles to the remaining scientific, economical, and practical work of the government. It will therefore be well for us here to consider all such work as is now being prose-

cuted under the supervision of committees of federal officers, and of which the following is an approximate list of names that suggest the great variety of intellectual work going on under the government: —

LEGISLATIVE BRANCH.

SENATE.

1. B. — Standing committee on agriculture and forestry.
2. A. — Standing committee on mines and mining.
3. B. — Standing committee on fish and fisheries (fish-commission).
4. D. — Joint committee on the library of congress.
5. B. — Joint committee on public buildings and grounds (botanical gardens).
6. B. — Select committee to investigate the introduction and spread of epidemic diseases.

HOUSE.

7. E. — Standing committee of coinage, weights and measures.
8. A. — Standing committee of rivers and harbors.
9. B. — Standing committee of agriculture.
10. B. — Standing committee of railways and canals.
11. A. — Standing committee of mines and mining.
12. A. — Standing committee of public buildings and grounds.
13. A. — Standing committee of levees and improvements of the Mississippi River.
14. D. — Joint committee on the library of congress.
15. A. — Select committee on ventilation and acoustics.

EXECUTIVE BRANCH.

16. A. — Executive mansion. Commissioner of public buildings, including greenhouses and propagating gardens.

STATE DEPARTMENT.

17. A. — Bureau of statistics.
18. D. — Bureau of rolls and library.

TREASURY DEPARTMENT.

19. Government actuary.
20. A. — Supervising architect's office.
21. C. — Bureau of engraving and printing.
22. B. — Bureau of statistics.
23. A. — Inspector-general of steamboats.
24. A. — Life-saving service.
25. B. — Commission on cattle-diseases.
26. B. — Commissioner of internal revenue.
27. C. — Director of the mint.
28. A. — Lighthouse board.
29. A. — Bureau of weights and measures.
30. A. — U. S. coast-survey.
31. A. — U. S. geodetic survey.
32. B. — Marine-hospital service.

WAR DEPARTMENT.

33. U. S. military academy at West Point.

Medical department.

34. Meteorological division.
35. B. — Medical museum, and medical history of the war.
36. Laboratory.
37. Library and bibliography.

Bureau of engineers.

38. A. — Mississippi-River commission.
39. A. — River and harbor improvements.
40. A. — Survey of Great Lakes.
41. A. — Survey of U. S. territory.
42. A. — Willett's Point school of engineering.

Public buildings and grounds.

43. Propagating gardens, aqueducts, Washington monument, etc.

Ordnance bureau.

44. Arsenals, armories, and ordnance depots.
45. Experiments on material, powder, etc.
46. Artillery school at Fortress Monroe.

Signal-service bureau.

47. A. — School at Fort Myer for meteorology and signalling.
48. A. — Weather-bureau.

NAVY DEPARTMENT.

49. U. S. naval academy at Annapolis.

Bureau of ordnance.

50. Manufacture of cannon, guns, arsenals, magazines.
51. Newport topedo station and service.

Bureau of navigation.

52. A. — Hydrographic office (charts, surveying, meteorology).

53. A. — Nautical almanac office.
54. A. — Naval observatory and chronometers.
55. A. — Compass and magnetic observatory.
56. *Bureau of steam engineering.*
57. *Bureau of construction and repairs.*
58. B. — *Bureau of medicine and surgery.*
59. B. — Museum of hygiene.

POST-OFFICE DEPARTMENT.

60. A. — Topographical division.

INTERIOR DEPARTMENT.

61. A. — General land-office.
62. C. — Patent-office (deals with all the sciences and their applications).
63. D. — Bureau of education.
64. Commissioner of railroads.
65. Geological and geographical survey.
66. D. — Census office.
67. Entomological commission.
68. National museum.

Agriculture bureau.

69. B. — Department of statistician and meteorologist.
70. B. — Department of entomologist.
71. B. — Department of botanist.
72. B. — Department of chemist.
73. B. — Department of microscopist.
74. B. — Department of forester.
75. B. — Department of experimental gardener.
76. B. — *National board of health.*
77. C. — *Civil-service commission.*

Commissioners for the government of the District of Columbia.

78. B. — Health office.
79. A. — Engineer's office.
80. A. — Surveyor's office.
81. D. — Superintendent of public schools.
82. *Smithsonian institution.*
83. B. — U. S. fish-commission (report to senate directly).
84. B. — Bureau of ethnology.
85. D. — National museum.
86. D. — Collections of U. S. geological surveys.
87. A. — Polaris report.

This list is sufficiently impressive. It is evident, that, in the growth of our nation and government, it has been necessary to undertake many works of general utility to the country, and to attack many questions in the sciences and the arts on which information is needed, either for the benefit of the legislative and the executive departments directly, or else with a view of distributing accurate information of immediate value broadcast throughout the land, for the benefit of the people at large.

Every thing relating to state relations, — diplomacy, war, law, finance, — it was easily seen in the beginning, must be conducted by the federal government. But matters of public domain — health, internal commerce, post-office, education, agriculture, patents, etc. — also demanded attention; and the departments of the interior, the land-office, and the bureau of agriculture, were provided. These special matters have so increased and subdivided, and have been so promiscuously assigned to various government bureaus, that often it is difficult to see any necessary connection between the nature of the work and the general character of the department under which it is now being conducted. If we were to re-arrange these eighty-seven items according to some approximate estimate of the intrinsic correlation of work, we should probably put the items marked A into one group: these all relate to surveys of land, with attending geodesy, standards of measurement, astronomical, physical, meteorological, oceanic, and geological work, and to such internal improvements as utilize the preceding.

In a second group, B, we should place all that relate to life and growth, health and disease, in the animal and vegetable kingdoms.

We should make a third group, C, of all that relates to manufacture of currency.

In the fourth group, D, we put all relating to the statistics and dissemination of useful knowledge.

This classification is theoretical or philosophical. If, on the other hand, we attempt something merely practical, we will perhaps re-arrange our subjects by simply selecting for the chief of each group that office which has at present the most successful organization, or which, being the largest, could most easily bear the addition of other branches. This would redistribute government work into the following bureaus: —

1. Bureau of surveys (including geodesy, astronomy, economic and military topography, geology, mineralogy, ethnology).
2. Bureau of hydrography and coast defence (including lighthouse and life-saving service).
3. Bureau of standards and adulterations (including physical and chemical laboratories for testing).
4. Bureau of hygiene.
5 Bureau of statistics.
6. Bureau of agriculture.

7. Bureau of mint and money.
8. Bureau of education (including pedagogy, library, museum).
9. Bureau of public works and improvements.
10. Bureau of patent-office.
11. Bureau of climate and weather.

We shall thus have eleven bureaus instead of the present numerous offices, and shall have succeeded in bringing together, in closer relation, a number of branches of public work. We may thus by so much succeed in simplifying the working machinery of the government, and possibly secure a slight economy and improved results; but we are still far from attaining that single scientific bureau, and thereby that recognition of science, which we are told is the general desire in this country, as also in others, and have by no means assured the general harmonious co-operation of these eleven bureaus in so far as that may be necessary. There is, in fact, no one of these bureaus whose operation is not more or less intimately associated with those of some others; and the ideal consolidation, when pushed to the extreme, would require the union of all these in one general department of science, education, and public works, — a slight combination, such as in these eleven offices still leaves unsatisfied the need of a higher general supervision.

Thus far we have only been considering the policy of the executive branch of the government as a business organization for the most economical administration of the laws originating in the legislative branch. If, however, we should consider what policy the legislative branch should adopt for the best welfare of the country, we should undoubtedly decide that it should give the greatest possible stimulus, first, to both the ordinary and the highest education of the people; second, to the execution of national works of public utility (especially taking into its own hands the conduct of any work of general importance, whenever that is neglected by private enterprise, or whenever it is monopolized by a few to the disadvantage of the mass of the people or of the government itself); third, to science and research as the means of developing the resources of nature and of the nation. Acting on these principles, other nations have, on the one hand, made a limited education compulsory, and, on the other, have provided the means for such education; they have demanded the highest attainments and the best work in each department of knowledge, and have provided universities and scientific schools where men can receive the necessary training; they have furnished most accurate topographic charts in order to facilitate the construction of roads, canals, and other internal improvements; they have displayed the greatest activity in labors relating to the public health, the development of agriculture, manufactures, and commerce, the prediction of storms and weather, protection against spurious coin and measures, adulteration, etc. In fact, most such other nations have exercised a more minute oversight over affairs, individually as well as collectively, than has been considered consistent with the liberty of the citizens in a republican government. It is perhaps not practicable for this nation, as yet, to go so far towards centralization as others have done; and yet we must look to our national legislature for some protection against the evils that arise from disconnected, and often discordant, individual actions. It must stimulate every one's work, and yet secure harmonious action on the part of those who are emulating each other both in public and private life. For instance: we have had, at one time, three or four topographical surveys, six or eight chemical laboratories, four or five meteorological bureaus, all in the government service, often working on the same or allied problems; while in civil life several other institutions can be found going over the same or similar ground. In this emulation and duplication lies the assurance that each will do his work to the best of his ability. The country, and the cause of knowledge, both profit by an occasional duplication of work: the whole progress of science consists in repeating the work of others in the light of newer discoveries or better knowledge, only it is necessary to know when such duplication is needed.

As the first and vital step towards a permanent improvement in the whole round of governmental work, we would not advise the diminution of government officials engaged in the above eighty-seven offices; we would not curtail the scope of the work carried on in each of those offices; we would not re-arrange them under some new classification, since even the best that can be thought of now is stiff, formal, and artificial, cannot foresee the progress of science, and will have to be changed a few years hence: we approve, rather, of the great diversity of work increasing every year, and carried on by the government for the benefit of the nation; the more work and workers, the greater stimulus given to the intellectual and material progress. Let each bureau do its work according to its own needs, whether these be military, ethnological, economic, statistic, topographic, or what not; but let there be somewhere an intelligent supervision of the whole field.

The natural intelligent head of the U. S. government is the legislative branch; and no great gain can result from a re-organization of the executive branch, without a corresponding enlightenment and improvement in the legislative. If any fault exists, or has existed, in the past and present administration of national scientific work, the trouble is not so much with the executive as with the legislative. The laws enacted by the latter, whether they result from suggestions from the country at large, or from the heads of departments, or their subordinates in Washington, are too often imperfect. Some public necessity starts the movement for the formation of a coast-survey, a weather-bureau, a geological survey; but all subsequent legislation is the result of a great deal of management on the part of the few men directly interested, who rarely give the subject the unprejudiced study that is needed in organizing such important concerns. One may know all about forestry or chemistry or statistical methods, may realize their practical importance, and may desire to inaugurate a bureau that shall push either of these subjects to the highest degree of perfection and usefulness; but when it comes to the questions where the bureau shall be placed (whether under military, naval, or civil laws), how the finances shall be administered, with what department it will best affiliate, and how wide its scope of duty shall be, the inaugurators of the new work are necessarily affected strongly by their limited knowledge or personal bias, that needs to be offset by a consultation with others of wider experience. The well-defined systematic statutes organizing the corps and work of the coast-survey (not the geodetic or the topographic survey); the engineer bureau; the Smithsonian institution; the fish-commission and other commissions; the land-office, post-office, patent-office, and other offices, — contrast strongly with the temporary fragmentary legislation referring to the work of the bureau of navigation, with its observatory, almanac, and hydrography, the census-office, geological surveys, signal-office, agricultural bureau, the library of congress, and other important national organizations. In general, it is well known that legislation touching scientific matters comes before congress from committees who have consulted with competent authorities to only a very slight extent; and especially do the more important actions taken by joint committees of conference almost invariably represent, not the wisdom of the wisest, but the will of the strongest, man on the committee. Any thorough solution of our trouble, any radical reform of existing evils, must provide for the infusion of greater scientific intelligence among our law-makers, and the presence among them of some authoritative board of appeal; so that, before turning over to the president and his cabinet a new item of public work, congress may have fully realized the probable bearings of other works upon it.

In 1863 the act organizing the National academy of sciences was enacted. This created a body of men eminently proper to act as advisers to the government upon any matter of science or its applications; and, as this advice is required by law to be given free of all charge, there have been numerous occasions on which such has been called for and given. Up to the end of 1883, forty-four such reports are enumerated; but we find only two such to have been called for by congress, and none by the judiciary, the rest having been requested by different members of the executive. In this respect we suggest that the legislative branch of government has omitted to derive all the benefit that was desirable from this body of representative scientific men. The president of this academy, in his annual reports, states fully any action taken by the academy each year, at the request of either branch of the government, but with a very delicate spirit offers no advice or comment not called for by the strict letter of the official requests. An act amending the act of 1863, and adding thereto a section requiring the president of the academy to make an annual report to congress on the present state of all national works bearing on science and its applications, with such recommendations as may have the sanction of the whole academy, would give this important body of men an opportunity to speak on behalf of scientific co-workers throughout the country, which opportunity is now offered only through some special request. A further amendment to said act, authorizing the academy at any time to communicate to either house of congress its views on the bearing of any proposed legislation without waiting for special request, would give the country assurance that the scientific, educational, and other interests of the country have at length an official representative who will be on the alert to defend their interests, and to avert injurious legislation. We believe these two amendments would go far towards providing a high tribunal, whose vigilance would insure greater wisdom in legislation; but the following third step is even more important. It is difficult for many outside of Washington to realize that any one who is an employee of the executive branch cannot, without incurring a reprimand, officially or privately approach any legislator with a view to influence legislation:

the law and the custom are quite strict upon this point. Occasionally a bold man will evade or break through diplomatic etiquette; but, as a rule, those members of the academy who happen also to be members of the executive are greatly hampered in any efforts to improve the relations between government and science. We therefore believe, that, before congress can obtain the free, untrammelled judgment of some of the best members of the national academy, it must relieve them individually and collectively from the operation of this objectionable law, and confer upon academicians liberty of speech on matters pertaining to the scientific policy of our national legislature. This great privilege, granted because of their recognized experience and the impossibility of otherwise obtaining the advice of the very men whom congress needs and has accepted as advisers, should be made a duty, and may possibly eventually bring with it a further condition; i.e., the membership of the academy, which is at present wholly a matter of election by its own members, might be in some way ratified by the senate so that congress may feel that its advisory academy is wholly in sympathy with itself. We conclude, then, by expressing the belief, that without a single abrupt immediate change in the relations of the scientific bureaus and offices of government, without any immediate revolution in the executive departments, without taking from any of the present chiefs his right and liberty to conduct the work committed him to the best of his knowledge and ability, but by three or four simple steps, we may quietly secure for the legislative branch of government such enlightenment and conservative advice as will eventually and rapidly lead to an improved and economical execution of the works now in hand; will insure satisfactory relations between science and the government; will assure the stimulation of scientific education and work, and the strengthening of the hands of such as honestly desire to promote the welfare of the people, rather than the creation of an aristocracy of government officers, or the execution of some petty personal scheme. X.